PHYSICS ABSTRACTS

SECTION A

of

SCIENCE ABSTRACTS

SECTION A, PHYSICS

SECTION B, ELECTRICAL ENGINEERING

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Non-destructive testing
Industrial radiography
Corrosion
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Electronic relays and counters
Automatic control mechanisms
Applied electrochemistry
Photocells
Thermionic tubes
Cathode-ray tubes
X-ray tubes
Induction accelerators
Cyclotrons
Amplifiers
Radio-wave propagation
Mechanical engineering
Heat engines
Illumination
Metallurgy

NOTE ON THE ARRANGEMENT OF ABSTRACTS

The Abstracts are classified by subject according to the Universal Decimal Classification, and arranged in order of their U.D.C. numbers, which are printed at the head of the Abstract on the left. Abstracts on any particular subject can be located by first consulting the abridged tables of the U.D.C. published with the January number, or the Annual Alphabetical Subject Index, and then referring to the appropriate U.D.C. number in the text. The main headings are listed above.

An Abstract of interest under more than one head has additional U.D.C. numbers, linked by the colon sign, ":" e.g. "536.21 : 548.0 Conduction of heat in crystals." The Abstract is printed once only, under the main number, e.g. in the section "HEAT 536," but Cross-references are inserted under the other numbers, e.g. "548.0 : 536.21 *see Abstr.* 1234" in the section "CRYSTALLOGRAPHY 548." These Cross-references should be investigated, therefore, when a particular section is being searched, as they contain additional matter relevant to that section. A Cross-reference does *not* refer to the Abstract which appears immediately above it.

[*Continued on page* 3 *of cover*

512.972 : 539.31 : 537.228.1 3067

Applications of tensor analysis to elasticity and piezo-electricity. JURMAIN, J. H. *J. Franklin Inst.*, **245**, 475–500 (*June*, 1948).—A systematic tensor development of elasticity, and a statement in tensor terms of piezo-electric theory. Simple applications are made to all of the elementary elastic deformation problems. A set of equations of motion is set up by the combination of the elastic and piezoelectric equations with Newton's laws of motion. Specific boundary conditions are placed upon these differential equations to obtain solutions for displacement and frequency of natural harmonic motion of bodies with particular dimensions and specific constraining conditions. A.

513.75 : 518.5 : 526.8 = 3 *see Abstr.* 3095

513.76 : 535.88 = 3 *see Abstr.* 3292

517.512.4 : 518.2 3068

Tables of the Bessel functions $Y_0(x)$, $Y_1(x)$, $K_0(x)$, $K_1(x)$, $0 \leqslant x \leqslant 1$. *Nat. Bur. Stand., Appl. Math. Ser.* (*No.* 1) 60 *pp.* (1948).—The values of $Y_0(x)$ and $Y_1(x)$ with first and second differences are given to 8 significant decimal places, over the range $x = 0(\cdot0001)0\cdot05(\cdot001)1$; the value of $K_0(x)$ and $K_1(x)$ with first and second differences are given over the range $x = 0(\cdot0001)0\cdot03(\cdot001)1$. L. S. G.

517.6 : 621.396.67 3069

Concerning a new transcendent, its tabulation and application in antenna theory. BOUWKAMP, C. J. *Quart. Appl. Math.*, **5**, 394–402 (*Jan.*, 1948).—The transcendent is

$$E_1(z) = \int_0^z t^{-1}E(t)dt,$$

where $E(z) = C(z) + iS(z) = \int_0^z (1 - e^{-it})t^{-1}dt$.

An asymptotic expansion for $E_1(z)$ is derived and tables of the values of the function, for $z = 0\cdot0\ (0\cdot2)\ 20\cdot0$, are given. An expression used by Hallén in his theory of aerials [*Nova Acta Reg. Soc. Sci. Upsaliensis*, **4** (*No.* 11) 1044 (1938)] is evaluated in terms of $E_1(z)$. L. S. G.

517.9 : 518.5 = 5 *see Abstr.* 3070

517.948 : 535.338.41 = 82 *see Abstr.* 3241

518.2 : 517.512.4 *see Abstr.* 3068

518.5 : 513.75 : 526.8 = 3 *see Abstr.* 3095

518.5 : 517.9 = 5 3070

On mechanical integration of differential equations. PASCAL, E. *Atti Accad. d'Italia* (*Mem. Classe Sci. Fis. Mat. Nat.*) **11** (*No.* 4) 209–43 (1940) *In Italian.*—Some integraphs suitable for the mechanical integration of several types of differential equations are described. Particular attention is paid to an important equation of atomic physics. The principles of mechanical integration are summarized; a bibliography is given. G. R.

518.5 : 621.3.011.1 = 3 3071

The logarithmic calculation cylinder for complex numbers. REINHARDT, F. *Elektrotech. Z.* [*ETZ*] **69**, 78–82 (*March*, 1948) *In German.*—By extending a logarithmically divided line to a logarithmically divided plane, the familiar slide-rule operations for calculating with real numbers were extended to analogous operations for complex numbers. Owing to the periodicity of the division the plane may be mapped on to a cylinder. The method is based on the conformal transformation, $w = \log z$, and this is discussed in detail. A photograph of a cylinder constructed for practical use is given. L. S. G.

518.5 : 621.317.39 : 548.73 *see Abstr.* 3527

518.5 : 621.318.572 3072

An electronic simultaneous equation solver. GOLDBERG, E. A., AND BROWN, G. W. *J. Appl. Phys.*, **19**, 339–45 (*April*, 1948).—An analogy device for directly solving simultaneous linear equations, without resorting to approx. methods, is described. It utilizes a number of high-gain amplifiers interconnected by networks whose elements bear definite relationships to the known coefficients and constants of the system of equations. The stability criterion for such a system, and its application to an equation solver are described. Since the device produces the answers to a system of equations without delay, it is readily adaptable to problems of synthesis as well as those of analysis. A.

518.5 : 621.318.572 3073

An electronic method for solving simultaneous equations. HARDY, A. C., AND DENCH, E. C. *J. Opt. Soc. Amer.*, **38**, 308–12 (*April*, 1948).—The equation-solving network of Abstr. 3562 (1948) can be stabilized by proper interconnection. The sum of 8 terms had to be determined, each of which is the product of either 3 or 4 independent variables. It was found that these individual products could be computed by making use of the fact that, if n events have probabilities of occurrence a, b, . . . n, respectively, the probability of their simultaneous occurrence is the product of their individual probabilities $abc \ldots n$. By generating rectangular waves of irrationally related frequencies whose pos. pulse widths $\propto$ the values of the unknown variables, and applying these signals to the grid of a valve in such a manner that its anode current flows only when all of the signals have pos. values simultaneously, the average value of the anode current $\propto$ the required product. When controlled in this way, 8 valves with their plates connected in parallel deliver an average current that $\propto$ the required sum. A.

518.5 : 621.318.572 : 534.321.9 *see Abstr.* 3192

519.2 : 541.124 *see Abstr.* 3481

519.21 : 541.64 3074

The average boundaries of statistical chains. HOLLINGSWORTH, C. A. *J. Chem. Phys.*, **16**, 544–7 (*May*, 1948).—A general problem of determining the average boundaries of statistical chains is solved formally. As a specific example, the average distance between the first link and the link (or links) which is farthest from the first link is calculated approx. for the case of a random chain. This value is only a small fraction $>$ the average distance between the end links. A.

519.271 3075

The curve of error in which the maximum error is defined. BRUGES, W. E. *Phil. Mag.*, **39**, 394–9 (*May*, 1948).—The curve, deduced from the binomial theorem, has a limit, and if the probable error, E, is known, the max. error should not exceed $3\cdot48 \ldots E$. L. S. G.

519.3 3076

Stokes' theorem and the vector integrand for line integrals in the calculus of variations. KIMBALL, W. S. *Phil. Mag.*, **38**, 842–79 (*Dec.*, 1947).—A continuation of previous papers [Abstr. 463 (1938)]. Differentiation before and after passing to the limit is discussed. Stokes' theorem does not hold for ordinary line integrals, but a suitable modification does. L. S. G.

523.11 : 523.4 *see Abstr.* 3079

523.11 : 523.877 = 3 3077

A model of the universe and the origin of stars. LUDWIG, G., AND MÜLLER, C. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 76–84 (1948) *In German.*—A discussion of an expanding universe with a decreasing constant of gravitation is based on field equations derived from projective relativity [Abstr. 2017 (1947)]. The case of zero pressure is introduced as a basis for Jordan's cosmology; the case, pressure = ⅓ energy density, is discussed in connection with Jordan's theory of the origin of stars. R. A. N.

523.165 : 621.396.822 3078

Measurement of galactic noise at 60 Mc/s. SANDER, K. F. *J. Instn Elect. Engrs, Pt IIIA*, **93** (*No.* 10) 1487–9 (1946).—Measurements were made of the extra-terrestrial noise picked up by a directive aerial on different bearings at different times of the day. This noise is expressed quantitatively by the equivalent temp. of the aerial radiation resistance. Temperatures between 1 800 and 10 000°K have been observed. A.

523.4 : 523.11 3079

The constitution of the planets. WILDT, R. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 1) 84–102 (1947).—The empirical bulk characteristics of the planets are summarized, neglecting as pertaining to an insignificant rind the properties deduced from photometric, radiometric and spectroscopic work. The data are then examined in relation to the ideal-gas and degenerate-gas models and to the models postulating two or more shells of different densities. Geochemical considerations, hitherto pointing to gravitational separation of different phases, may now admit of the homogeneous-interior model. Cosmogonic aspects of planetary structure are briefly outlined. A. HU.

523.4 : 523.877 3080

On the internal constitution of the planets. SCHOLTE, J. G. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 237–41 (1947).—The equation of state of matter at high pressure is obtained using the Thomas–Fermi electron distribution. An approx. solution shows that the planets are of the Laplace type. The max. radius of a planet is ~1·5× that of Jupiter. Jupiter and Saturn are so large that they must be composed of H. The mass-radius relation observed for the terrestrial planets is consistent with that expected for a Si planet. A. HU.

523.5 : 621.396.812.3 : 551.594.6 *see Abstr.* 3555

523.53 : 621.396.9 : 551.510.535 *see Abstr.* 3551

523.531 : 621.396.9 3081

Radio echo observations of meteors. PRENTICE, J. P. M., LOVELL, A. C. B., AND BANWELL, C. J. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 155–63 (1947).—The vertical-beam apparatus used to observe 1836 meteor reflections at 72·4 Mc/s between June and Aug. 1946 is described. Good correlation with visual observations during the appearance of the Perseids was obtained with echoes lasting > ½ sec, but not for echoes of shorter duration. The distribution of range, amplitude and duration of echoes is discussed, and the daily rate of occurrence is interpreted in terms of known showers. The Perseids affect the hourly rate less than expected but increase markedly the proportion of long-duration echoes. A quantitative relation derived between meteoric ionization and echo amplitude verifies the observed correlations if all the echoes are of meteoric origin. A. HU.

523.531 : 621.396.9 3082

Radio echo observations of the Giacobinid meteors, 1946. LOVELL, A. C. B., BANWELL, C. J., AND CLEGG, J. A. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 164–75 (1947).—A narrow-beam directional aerial was used for 71 h continuously between Oct. 8–11. With the aeri directed at 90° from the radiant and sending pulses λ = 4·2 m, the rate approximates to the visual rate f one observer; it reached a sharp max. of 168/min 0340 hrs on Oct. 10, the whole display being over in 6 h Changes in the height distribution, durations and amp tudes during this time may indicate changes in the show characteristics. A. H

523.531 : 621.396.9 308

Radar observations of the Giacobinid meteor showe 1946. HEY, J. S., PARSONS, S. J., AND STEWART, G. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 176–83 (1947).— Vertical-beam equipment was used to record the show at λ = 5 m. The hourly rates, range distributio and signal-strength distribution are discussed. The fi structure of many echoes reveals a faint, fast-movi echo, prior to the formation of the main echo, which attributed to reflection from the ionized region near t meteor itself, as distinct from the broadside train. F 22 such tracks the mean geocentric velocity is 22·9 km/se in good agreement with the astronomical value 23·7 km/sec. A. HU

523.72 : 551.521.64 308

The solid angle of the corpuscular solar radiatio GNEVISHEV, M. N., AND OL, A. I. *Terr. Magn. Atmo Elect.*, **51**, 163–70 (*June*, 1946).—The solid angle of t corpuscular solar radiation may be evaluated by usi data on: (1) The duration of the magnetic storms; (2) t increase of geomagnetic activity during the equinocti seasons; (3) the correlation-coefficients between magne activity and area of sunspots in the central zones wi different radii; (4) the lag of the 11-year variations geomagnetic activity in comparison with the solar ind owing to Spörer's law. The value indicated is 8–9°.

523.72 : 621.396.821 308

Shape of pulses of radio-frequency radiation from the su WILLIAMS, S. E. Letter in *Nature, Lond.*, **162**, 108 (*July* 1 1948).—Pulses of 75 Mc/s radiation were recorded on moving film oscillograph, and the "tails" of 78 wer analysed. 58 were found to be probably exponential decay, 15 doubtful, and 5 definitely not. The "½-lives of the exponential decays varied from ½ to 2 sec, t majority being ~ 1 sec. There did not seem to be an correlation of decay time of pulses appearing clos together in time.

523.743 : 523.755 308

Granulation, magneto-hydrodynamic waves, and t heating of the solar corona. ALFVÉN, H. *Mon. Not. R Astr. Soc.*, **107** (*No.* 2) 211–19 (1947).—Turbulen granules in the photosphere produce magneto-hydr dynamic waves which are transmitted upwards to th chromosphere and corona. Their energy is estimated a 1% of that radiated by the sun. They are damped mainl in the inner corona, where the heat they generate produce the observed temperature of about 10^6 deg. A. HU

523.75 308

On the structure of the solar corona and chromosphere BONDI, H., HOYLE, F., AND LYTTLETON, R. A. *Mon. No R. Astr. Soc.*, **107** (*No.* 2) 184–210 (1947).—The accretio of interstellar H by the sun is shown to produce a con vective atmosphere with properties closely resemblin those of the corona and chromosphere. A moderat accretion rate can produce the observed coronal tem perature of 10^6 deg. The interpenetration or 2-strea region in the outer layers is succeeded by a 1-strea

region extending to the top of the reversing layer. Neither conduction nor radiation suffices for the transport of energy downwards, and the problem becomes one of convection currents projected from above into a stable atmosphere in which temperature increases with height. The equations of motion are derived and solved, and numerical values calculated for various physical quantities in the 2 regions. Non-steady states are discussed, and prominences are regarded as regions of local cooling in the inner corona. A. HU.

523.755 : 523.743 *see Abstr.* 3086

523.76 3088

On the angular momentum of the sun. LUNDQUIST, S. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 27) 6 *pp.* (1948) *In English.*—Assuming a point-convective model of the sun, and that the angular velocity of the sun is constant over the surface traced by rotating a magnetic line of force through four right angles, the angular momentum P of the sun is computed for (*a*) a homogeneous field-dipole magnetic field, and (*b*) Cowling's decaying magnetic field. The author finds that $P \times 10^{-48}$ ranges from 1·73 to 1·92 in case (*a*) and from 1·48 to 1·54 g.cm^2 sec^{-1} in case (*b*). V. C. A. F.

523.77 3089

The continuous spectrum of the sun. DEUTSCH, A. J. *Rev. Mod. Phys.*, **20**, 388–98 (*April*, 1948).—Comprehensive critical summary of the recent theoretical work (due particularly to Chalonge and Kourganoff, Chandrasekhar, Strömgren, Unsöld, Wildt), which achieved successfully the physical interpretation of nearly all the observed facts in the continuous solar spectrum. A. B.

523.841 : 523.877 *see Abstr.* 3093

523.841.1 : 523.841.37 : 523.877 *see Abstr.* 3094

523.841.37 : 523.841.1 : 523.877 *see Abstr.* 3094

523.872 : 535.335 3090

Astronomical spectroscopy. PLASKETT, H. H. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 1) 117–50 (1947).—Spectroscopic methods of determining the numbers of atoms in various stages of excitation and ionization in stellar atmospheres are reviewed. The atomic line-absorption coefficient for a quantum-atom at rest is deduced, and the fundamental differential equation of transfer is derived and its integration discussed in particular cases. Possible sources of anomalies in observed curves of growth for the sun and for bright stars are discussed. Future work should be directed to the observational determination of equivalent widths; to the laboratory determination of oscillator strengths and ½-widths due to radiation damping and impact broadening; and to removing limitations on the equation of transfer. A. HU.

523.877 3091

On stability of gaseous spheres. SOROKINA, A. *C.R. Acad. Sci. URSS*, **54** (*No.* 8) 677–80 (1946) *In English.*—The spheres are in equilibrium under the action of their own gravitation, and it is assumed that the pressure is a function of the density only; this model corresponds to a white dwarf. The equation of equilibrium is written down, and a disturbed state (small change in density) is investigated by a perturbation method. It is concluded that gaseous spheres are stable for all non-radial perturbations. L. S. G.

523.877 = 4 3092

On a method of integration of the equations of equilibrium for stellar atmospheres. PECKER, J.-C. *C.R. Acad. Sci., Paris*, **226**, 561–3 (*Feb.* 16, 1948) *In French.*—Kourganoff's method [Abstr. 1757 (1948)] is extended to cover scattering by free electrons. R. A. N.

523.877 : 523.11 *see Abstr.* 3077

523.877 : 523.4 *see Abstr.* 3080

523.877 : 523.841 3093

Note on equilibrium configurations for rotating white dwarfs. HOYLE, F. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 231–6 (1947).—The Chandrasekhar upper limit on the mass of a degenerate equilibrium configuration is shown to disappear if the star rotates. The existence of an equilibrium state does not, however, mean that it is necessarily attainable by a collapsing star; when the limiting mass is exceeded a collapsing star must pass through rotational instability. White dwarfs of large mass therefore become rotationally unstable and are not observed. A. HU.

523.877 : 523.841.1 : 523.841.37 3094

Nova and Cepheid instabilities accompanying nuclear reaction in the shrinkage after and before a star's steady maintenance. JOHNSON, M. *Mon. Not. R. Astr. Soc.*, **107** (*No.* 2) 220–30 (1947).—The abundances are derived of light nuclei which will permit energy liberation at a rate equivalent to the excess luminosity of some pulsating and erupting stars. Conditions are discussed in which certain stellar models of specified mass and composition capable of releasing the required energy may seek relief periodically or catastrophically from a rate of generation exceeding that of the corresponding steady star. Cepheids are regarded as pulsating before and some novae as erupting after the Bethe stage. A. HU.

525.37 : 531.114 : 591.185.63 *see Abstr.* 3556

526.8 : 513.75 : 518.5 = 3 3095

Coordinate transformation with duplex calculating machines. LITSCHAUER, J. *Öst. Ingen.-Arch.*, **2** (*No.* 1) 18–63 (1947) *In German.*—In surveying and geodesy it is necessary to transfer the co-ordinates of points in different types of projections, taking the ellipsoidal shape of the earth into account. The paper develops a rapid method of co-ordinate transformation of large numbers of points, suited especially to calculating-machines allowing multiplication and consequent addition. Transformation of geographical co-ordinates into various usual systems of projection is explained and general formulae are given. Worked examples show applications of the method. V. W. R.

526.918.5 : 778.35 *see Abstr.* 3065

PHYSICS 53

53 3096

Physics in 1947. MORRISON, P. *J. Appl. Phys.*, **19**, 311–31 (*April*, 1948).—A short review of selected subjects (12 figs., 39 refs.).

FUNDAMENTALS 530.1

530.12 = 4 3097

Fundamental origins and the idea of mass in classical and wave mechanics. DESTOUCHES-FÉVRIER, P. *C.R. Acad. Sci., Paris*, **226**, 635–7 (*Feb.* 23, 1948) *In French.*—The distinction of Eddington between objective co-ordinates in which all actions are point interactions, and the systems of an observer, which lies at the mean position of the former, is discussed. G. J. K.

530.12 : 538.312 *see Abstr.* 3392

530.14 : 538.3 = 4 3098

The interaction between matter and radiation, the uncertainty constant and the proper energy of the electron.

CAZIN, M. *C.R. Acad. Sci., Paris*, **226**, 641–3 (*Feb.* 23, 1948) *In French.*

530.14 : 538.3 = 4 3099

The effect of the principle of respective co-ordinate systems on the interaction between matter and radiation. DESTOUCHES, J. *C.R. Acad. Sci., Paris*, **226**, 639–41 (*Feb.* 23, 1948) *In French.*—Using the distinction between objective and subjective co-ordinate systems [Abstr. 3097 (1948)] electromagnetic potentials are obtained with a Gaussian function which eliminates divergences. G. J. K.

530.14 : 539.152.1 : 539.18 3100

Mesons and nucleons. KLEIN, O. *Nature, Lond.*, **161**, 897–9 (*June* 5, 1948).—The hypothesis is advanced that the ordinary cosmic-ray meson (μ-mesons) and its neutral counterpart interact by means of a Yukawa field; the particles corresponding to this interaction, whose role is similar to photons, are termed "electrophotons" to distinguish them from ordinary mesons. Some σ-mesons may be of this kind. π-mesons, and possibly other mesonic particles of higher mass, are supposed to be metastable compound systems of mesons held together by means of the above interaction. Moreover, it is suggested that the nucleons themselves are stable compound systems of mesons, e.g. the neutron is built up of 17 neutral mesons, 6 in *p*-states, 10 in *d*-states, and one *s*-state particle. The hypothesis is discussed on a quantitative basis.

530.145 = 4 3101

Uncertainty relations associated with the complementary particle-systems of de Broglie. DESTOUCHES-FÉVRIER, P. *C.R. Acad. Sci., Paris*, **226**, 468–70 (*Feb.* 9, 1948) *In French.*

530.145 = 4 3102

The "left" vector calculus and the relativistic invariance of Dirac's equation. VIARD, J. *C.R. Acad. Sci., Paris*, **226**, 637–9 (*Feb.* 23, 1948) *In French.*

530.145 = 4 3103

Remarks on the coalition of two Dirac particles. TONNELAT, A. *C.R. Acad. Sci., Paris*, **226**, 783–5 (*March* 8, 1948) *In French.*

530.145 = 4 3104

The principal families of probability functions and their properties. ARNOUS, E., AND MASSIGNON, D. *C.R. Acad. Sci., Paris*, **226**, 785–7 (*March* 8, 1948) *In French.*—See Abstr. 2300–1 (1948).

530.145 : 534.01 = 3 *see Abstr.* 3169

530.145 : 537.534.74 : 539.185 3105

The neutron-proton scattering formula: remark on the letter of Flügge and Hückel. WU, T. Y., AND FOLEY, H. M. Letter in *Phys. Rev.*, **73**, 1117 (*May* 1, 1948).—See Abstr. 2013 (1948). The expression for the scattering cross-section in the singlet state is criticized as being obtained by approximations which were not consistently made, even with the new definition of the energy ε of the virtual level. It is pointed out that the value of the cross-sections depend only on the potential and cannot depend on the choice of definition of ε. G. J. K.

530.145 : 537.534.74 : 539.185 3106

Neutron-proton scattering and the range of nuclear forces. WU, T. Y. Letter in *Phys. Rev.*, **73**, 1132 (*May* 1, 1948).—It is suggested that a "symmetric" type of exchange potential, with different ranges in the singlet and triplet states, together with a small tensor force, will give the observed low ratio of backwards (180°) to transverse (90°) scattering of neutrons by protons at 100 MeV. Results are given of calculations with various ranges for square-well and Gaussian potentials. G. J. K.

530.145.1 3

Space-time approach to non-relativistic quant mechanics. FEYNMAN, R. P. *Rev. Mod. Phys.*, 367–87 (*April*, 1948).—A new formulation of n relativistic quantum mechanics mathematically equival to the familiar formulation is made. The probability an event which can happen in several different ways is absolute square of a sum of complex contributions, c from each alternative way. The probability that particle will be found to have a path $x(t)$ lying somewh within a region of space time is the square of a sum contributions, one from each path in the region. T contribution from a single path is postulated to be exponential whose (imaginary) phase is the classical acti (in units of $\hbar$) for the path in question. The total cont bution from all paths reaching x, t from the past is wave function $\psi(x, t)$. This is shown to satisfy Schr dinger's equation. The relation to matrix and opera algebra is discussed. Applications are indicated, particular to eliminate the co-ordinates of the fi oscillators from the equations of quantum elect dynamics.

530.145.6 3

The interactions of nucleons with meson fields. Dys F. J. Letter in *Phys. Rev.*, **73**, 929–30 (*April* 15, 1948) By a gauge transformation, an alternative proof is giv of a remark by Nelson [Abstr. 846 (1942)] that the pseu vector (H_1) and the pseudo-scalar (H_2) types of interacti between nucleons and a pseudo-scalar meson field are many problems equivalent; and in particular give the sa interaction potentials. This is true despite the fact t H_2 seems to be negligible for nucleons with sm velocities. When applied to other meson fields t method shows that a scalar or pseudoscalar field has o one distinct type, and a vector or pseudo-vector only t distinct types of interaction with nucleons. G. J.

530.145.6 3

On the counting of nodal curves and surfaces. WINTN A. *J. Chem. Phys.*, **16**, 405–6 (*April*, 1948).—Sturm theorem on the nodal curves or surface of the wa equation is extended to apply to potential fields c responding to which the wave equation is not separab

530.145.6 : 531.19 3

On the Sturm–Liouville problem connected with continuous spectrum. HULTHÉN, L. *Ark. Mat. Astr. F* **35 A** (*Paper* 25) 14 *pp.* (1948) *In English.*—The variatio procedure for the determination of the asymptotic pha in the continuous spectrum [Abstr. 491 (1945)] is give simplified form. The equation for the difference betwe the strict and the asymptotic solution is expressed a variational problem with an auxiliary condition. procedure for improving the derived value of the phase given. This is exemplified by the determination of pha for a meson potential. G. J.

GENERAL MECHANICS . MECHANICS SOLIDS 531

531.011 3

The axioms of Newtonian mechanics. SIMON, H. *Phil. Mag.*, **38**, 888–905 (*Dec.* 1947).—Mach's laws motion are stated and discussed. Mass is defined a comment is made upon the dependence of mass on reference system. Force is next introduced and the id of the acceleration "induced" in one body by anoth The determination of mass does not depend on specification of a law of force. L. S.

531.114 : 525.37 : 591.185.63 *see Abstr.* 3556

531.19 : 530.145.6 *see Abstr.* 3110

531.19 : 532.7 *see Abstr.* 3149

531.19 : 539.22 *see Abstr.* 3465–6

531.25 3112

The large deflection of simply supported beams. CONWAY, H. D. *Phil. Mag.*, **38**, 905–11 (*Dec.*, 1947).—A theory of large deflections, in which Hooke's law is not exceeded, e.g. in the design of flat springs, is developed. The problem of a beam simply supported at each end and carrying a central load is discussed. The max. deflection is slightly greater than that predicted by simple theory. The load/deflection curve is not linear, the deflection increment increasing with corresponding load increments. L. S. G.

531.252.2 3113

The stresses in a plate containing an overlapped circular hole. LING, C.-B. *J. Appl. Phys.*, **19**, 405–11 (*April*, 1948).—The stress function is constructed by means of an even integral solution of the biharmonic equation expressed in bipolar co-ordinates. The parameters involved in the solution are determined from the given boundary conditions with the aid of Fourier transforms. Three fundamental stress systems are discussed. Expressions are derived for the stress along the rim of hole and values of the maximum stress are calculated. A.

531.259 3114

Three dimensional stress systems in isotropic plates. I. GREEN, A. E. *Philos. Trans. A*, **240**, 561–97 (*April* 2, 1948).—A general analysis is made of the stress distributions in a plane infinite plate of finite thickness, containing a circular cylindrical hole. The faces of the plate are free from applied stress. The problem of a plate under uniform tension in a direction parallel to its faces is solved. The mathematical analysis involves use of Fourier series and infinite integrals involving Bessel functions. L. S. G.

531.259 3115

Three-dimensional stress systems in isotropic plates. II. GREEN, A. E., AND WILLMORE, T. J. *Proc. Roy. Soc. A*, **193**, 229–48 (*May* 27, 1948).—The problem of an isolated force uniformly distributed through a plate of finite thickness and acting parallel to the faces of the plate, which are free from applied stress, is solved in integral form. Numerical work is carried out for the average values of the stresses in order to compare the results with those found from the approximate theory of generalized plane stress. In addition, numerical values of the stresses are found on the faces of the plate and on the plane midway between the faces. A.

531.564 = 3 3116

The influence of wind on normal trajectories. ROTH, E., AND SÄNGER, R. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 108–18 (*April*, 1948) *In German.*—A mathematical study of the variation due to wind of the path of a projectile. Expressions are found for the change in the range and time of flight when the wind has a constant velocity in the plane of the trajectory. Then the effect of a wind possessing, in addition, a velocity component normal to this plane is discussed. Winds with a variable velocity are next considered. Some numerical examples are given. L. S. G.

531.578 3117

Explosives with lined cavities. BIRKHOFF, G., MACDOUGALL, D. P., PUGH, E. M., AND TAYLOR, G. *J. Appl. Phys.*, **19**, 563–82 (*June*, 1948).—The penetrating power of explosive charges containing cavities is enormously increased if the cavity is lined with thin metal sheet. A mathematical theory of this effect is worked out and some experimental data presented. The metal liner is formed into a thin jet travelling at high velocity (30 000 ft/sec) which forces aside the target material (pressure $\simeq 0{\cdot}3 \times 10^6$ atmos). The theory of both these phases is based on classical hydrodynamics of perfect fluids. A.

MECHANICAL MEASUREMENTS 531.7

531.717.1.082.74 : 621.317.39 3118

Thickness gage for moving sheets. HEAD, J. W. *Electronics*, **21**, 90–2 (*May*, 1948).—[Abstr. 2713 B (1948)].

531.72 : 535.24 = 3 3119

A simple relation between the surface area and the profile of a body. KINDER, W. *Optik*, **2**, 396–8 (*Oct.–Nov.*, 1947) *In German.*—It is shown that the mean profile area of a body which is nowhere concave = ¼ of the surface area. The profile area in a given direction is defined as the area of the figure produced by parallel projection in that direction. The result can be applied to problems in photometry. H. H. HOP.

531.76 : 534.232 : 621.317.39 3120

The absolute calibration of electromechanical pickups. TRENT, H. M. *J. Appl. Mech.*, **15**, 49–52 (*March*, 1948).—[Abstr. 2465 B (1948)].

531.761 : 621.318.5 : 621.317.39 = 393 3121

Measurement of operation time of neutral relays by the valve method. SNIJDERS, A. *PTT-Bedrijf*, **1** (*No.* 4) 142–7 (1947–48) *In Dutch.*—[Abstr. 2466 B (1948)].

531.787 3122

Simplified absolute and differential manometer. GILMONT, R. *Analyt. Chem.*, **20**, 474–7 (*May*, 1948).

531.788.6 3123

An investigation on hot-wire vacuum gauges. II. VON UBISCH, H. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 28) 12 *pp.* (1948) *In English.*—See Abstr. 2041 (1947). Practical aspects of design of hot-wire (Pirani) gauges are discussed. Three compensated W wire gauges, with filament resistances 5·5, 85 and 294 Ω respectively at 20°C, are described. Calibration curves are given for air, A, CO_2 and H_2. Associated circuits for battery or a.c. line operation are shown diagrammatically. The constructional details and performance curves of a metal needle valve, sealed with greased "Gaco" packings, are given. S. W.

531.788.7 3124

A new hot-wire vacuum gauge. VON UBISCH, H. Letter in *Nature, Lond.*, **161**, 927–8 (*June* 12, 1948).—The wire is heated by current from a 800 c/s regenerative amplifier circuit, and the oscillation amplitude adjusts itself to keep the wire temperature constant. An extended spiral of 0·01 mm W wire is used, and readings may be made from 0·01–100 mm Hg.

MECHANICS OF LIQUIDS 532

532.12 : 539.42 3125

Study of the Berthelot method for determining the tensile strength of a liquid. SCOTT, A. F., SHOEMAKER, D. P., TANNER, K. N., AND WENDEL, J. G. *J. Chem. Phys.*, **16**, 495–502 (*May*, 1948).—An attempt was made to test directly the supposition that the high values for the tensile strengths of liquids as found by the Berthelot method are due to the trace of air ordinarily present in the Berthelot tube. A method is described for preparing Berthelot tubes in an evacuated system, using water from which air had been carefully removed. Measurements with these air-free tubes yielded 32 atmospheres as the average maximum hydrostatic tension that water can withstand.

This value for the maximum tension is in good accord with the evidence of other investigators. A.

532.13 : 621.891.2 = 3 3126

Structural viscosity as the cause of lubricating properties. UMSTÄTTER, H. *Technik*, **1**, 46–52 (*July*, 1946) *In German.*—The viscosity of colloidal lubricants decreases with increasing velocity gradient. Tangential pressure plotted *v.* velocity gradient on a log/log scale gives the "flow curves" for the material, the gradient of which is a measure of lubricating value called "slippiness." Structure-viscous oils are shown to give more uniform hydraulic pressure distribution in bearing clearances than standard oils. This enables a reduction in bearing sizes for a given load when using structure-viscous oils. The optimum results are obtained when the "slippiness" is a max. for the max. velocity gradient occurring in the bearing. V. W. R.

532.133 : 541.182.6 3127

Viscosity of solutions and suspensions. I. Theory. VAND, V. *J. Phys. Coll. Chem.*, **52**, 277–99 (*Feb.*, 1948).—Considering mutual interaction of, and collisions between, particles, the relative viscosity η_r of suspensions of rigid spheres at a volume concentration c becomes $\log \eta_r = (k_1c + r_2(k_2 - k_1)c^2 + \ldots)/(1 - Qc)$ where $K_1 = 2{\cdot}5$ (Einstein shape factor of single spheres), $k_2 = 3{\cdot}175$ (shape factor of collision doublets), $r_2 = 4$ (collision time constant) $Q = 0{\cdot}609$ (hydrodynamic interaction constant), these values applying to rigid, non-solvated spheres without mutual forces or Brownian movement. For artificial suspensions and solutions over a wide range of concentrations the formula up to 2nd order terms seems to be accurately valid and in very good agreement with observed values. The wall effect was measured and found to correspond to the effect of a layer of thickness $D = 1{\cdot}301\ a$ of the liquid, a being the radius of the spheres.

532.133 : 541.182.6 3128

Viscosity of solutions and suspensions. II. Experimental determination of the viscosity–concentration function of spherical suspensions. VAND, V. *J. Phys. Coll. Chem.*, **52**, 300–13 (*Feb.*, 1948).—The viscosity of suspensions of rigid spheres was measured in a range of concentrations 0–50%. Glass spheres having an average radius of 0·0065 cm suspended in Zn iodide solution were used, and the measurements were corrected for wall effects. The results were compared with a theoretical formula; the agreement is satisfactory. A.

532.133 : 541.182.6 3129

Viscosity of solutions and suspensions. III. Theoretical interpretation of viscosity of sucrose solutions. VAND, V. *J. Phys. Coll. Chem.*, **52**, 314–21 (*Feb.*, 1948).—The theoretical viscosity formula derived for suspension of rigid particles, combined with the density data, is applied to solutions of sucrose. Information is thus obtained on hydration, collision constants, and densities of the molecules and their hydration envelopes. A.

532.137 3130

An accurate microviscometer. GLYNN, E., AND GRUNBERG, L. *J. Inst. Petrol.*, **34**, 331–8 (*May*, 1948).—A microviscometer based upon the method devised by Bingham and Murray [*Proc. Amer. Soc. Test. Mater.* **23**, 655 (1923)], wherein the flow of the liquid from a reservoir under a constant applied pressure into a horizontal empty capillary tube is measured, is described. The radius chosen for the diameter of the capillary depends on the viscosity to be measured: for viscosities 1–100 poise, $d = 0{\cdot}01$ cm; for viscosities 100–1 000 poise, $d =$ up to $0{\cdot}03$ cm. The weights of liquid used in the respective cases range from 10 to 15 mg and 40 to 80 m The accuracy obtainable $\simeq 0{\cdot}5\%$. J. S. G.

532.14 31

Correlating densities of liquids. OTHMER, D. JOSEFOWITZ, S., AND SCHMUTZLER, A. E. *Indus Engng Chem.*, **40**, 883–5 (*May*, 1948).—Densities liquids may be plotted directly to give straight lines logarithmic paper against a temperature scale develop from the critical temperature and densities of a referen liquid. The method of correlation follows the techniq used for vapour pressures, viscosities, surface tensio and other physical properties of liquids and gases and then expanded into a nomograph which allows dire determination of the density of organic liquids at a temperature when the density for that liquid at t different temperatures is known. Mathematical deriv tions indicate the theoretical basis of this plot and t resulting nomograph.

532.14 : 535.324 *see Abstr.* 3223

532.513.032 : 533.6.01 *see Abstr.* 3164

532.516 : 539.27 : 539.23 *see Abstr.* 3467

532.517 = 82 31

Undular flow of thin layers of a viscous fluid. I. Fr flow. KAPITZA, P. L. *J. Exp. Theor. Phys.*, 3–18 (*Jan.*, 1948) *In Russian.*—The paper deals with t flow of thin layers of a viscous liquid under the action a constant volume force, allowing for surface tensio An approximate solution of the equation of flow w found which showed that the undular flow establish experimentally by a series of workers had a more stab character than the laminar flow. Wave shape, pha velocity, and amplitude are given. The theoretic values of the critical factors Re_K characteristic for t inception of the undular flow agree with the experimen data. The rapid dispersion of colouring matter alo the flow observed by Friedman and Miller [Abstr. 19 (1941)] is quantitatively explained by the undul character of the flow.

532.517 : 533.6.011.31 : 536.27 = 82 31

Undular flow of thin layers of a viscous liquid. Flow in contact with a gas flow and with heat transf KAPITZA, P. L. *J. Exp. Theor. Phys.*, **18**, 19–28 (*Ja* 1948) *In Russian.*—The paper deals with the inte reaction of a gas flow with the flow of a liquid. On t assumption of an interruption in the gas flow occurri where it makes intimate contact with the wave surface the liquid it becomes possible to explain and defi numerically the increased pressure drop in a gas strea ing through pipes with moist walls. The expression f the critical velocity at which the gas current is "choke in a vertical pipe along the walls of which there is liquid counterflow is in good agreement with test result Finally, the increase of the thermal conductivity of th layers of a liquid in an undulating condition is estimate

532.517.4 31

The spectrum of locally isotropic turbulence. KOVAS NAY, L. S. G. Letter in *Phys. Rev.*, **73**, 1115–16 (*May* 1948).—Kolmogoroff in his recent work and Batchel [Abstr. 542 (1948)] employ a picture of the full developed turbulence at high Reynolds numbers as a "eddy-cascade" in which the k.e. of the larger-sca eddies is transferred to the smaller by the Reynol stresses of the small scale motion. Assuming similari in this turbulent energy transport mechanism, a neglecting viscosity, several authors have derived "$\frac{5}{3}$-power law" for the spectrum of the medium frequen range. Making the assumptions that (1) the k.e. p

unit mass that passes in unit time through frequency n depends only on the spectrum function, $F(n)$, and n, and (2) that the mechanism of turbulent energy transport is independent of viscosity, the author shows that $F(n) = F_0(n/n_0)^{-5/3}[1 - (n/n_0)^{4/3}]^2$ where F_0 and n_0 are constants, and $R_0 = (F_0/n_0)^{1/2}\nu$, is a universal constant (Reynolds number), ν being the kinematic viscosity. Theoretical results agree well with experimental results obtained by Simmons and Salter [Abstr. 1433 (1938)]. J. S. G. T.

532.525 : 536.711 : 533.17 *see Abstr.* 3156

532.543 3135

Flow of a liquid from a reservoir over a plane. Boundary-layer theory. RAY, M. *Phil. Mag.*, **39**, 409–12 (*May*, 1948).—The theory of growth of the layer, when the liquid is allowed to flow from the reservoir over a plane through a wide aperture, is considered. Any section of the layer increases rapidly at first but the growth slows down with time. L. S. G.

532.57 : 621.383 : 621.317.39 3136

Measuring liquid flow by weight. KENDALL, D. B. *Electronics*, **21**, 114–16 (*May*, 1948).—[Abstr. 2715 B (1948)].

532.59 3137

Two fundamental theorems on gravity waves in inhomogeneous incompressible fluids. GROEN, P. *Physica, 's Grav.*, **14**, 294–300 (*June*, 1948) *In English.*—A differential equation is derived for the stream function of simple harmonic small amplitude gravity waves in a stratified incompressible fluid. From this it is proved in a general way that the periods of such waves are monotonic increasing functions of the wavelength and that they have a lower limit which $\propto$ (absolute maximum of the vertical density gradient)$^{-\frac{1}{2}}$. A.

532.59 : 541.126 3138

Surface waves from an underwater explosion. KIRKWOOD, J. G., AND SEEGER, R. J. *J. Appl. Phys.*, **19**, 346–60 (*April*, 1948).—A general expression is derived for the pressure due to the surface waves. The integrals involved were evaluated in terms of dimensionless variables over a range of practical interest. A specific formula is given for the pressure on the bottom of the water due to the first pulsation of the gas globe from a TNT explosion originating also on the bottom. A.

532.593 3139

The refraction of surface waves by currents. JOHNSON, J. W. *Trans. Amer. Geophys. Un.*, **28**, 867–74 (*Dec.*, 1947).—When ocean waves, moving through deep still water, encounter a current, moving at an angle with the wave direction, the waves undergo a change in length, steepness, and direction of travel. A theoretical development is given for these factors in terms of initial wave length and direction, and the magnitude of the current. Discussion is given of the action of a coastal current in affording protection against short period waves. A.

CAPILLARITY 532.6

532.61 = 4 3140

Condition for the adhesion of perfect incompressible fluid to a [boundary] wall in mechanics. BRARD, R. *C.R. Acad. Sci., Paris*, **226**, 556–7 (*Feb.* 16, 1948) *In French.*—This brief note establishes the validity of the notion proposed by Roy regarding the origin of the lift of an aerofoil, and seeks to define precisely the distribution of turbulence in the Prandtl limiting layer, referred to in Roy's theory. J. S. G. T.

532.612.4 3141

Correlating surface tensions of liquids. OTHMER, D. F., JOSEFOWITZ, S., AND SCHMUTZLER, A. F. *Industr. Engng Chem.*, **40**, 886–9 (*May*, 1948).—Using techniques developed for many other physical properties, surface tensions of a liquid at various temperatures have been correlated to give straight-line plots on logarithmic paper against the surface tensions of a reference liquid at constant values of the critical difference temperature. The algebraic expression is: $\log \gamma = m \log \gamma' + C$. This may be shown to be derived simply from the expression $\log \gamma = n \log T_D + K$, which in turn comes directly from the expression first proposed by Eötvös in 1886. In these equations n, m, C, and K are constants, γ is the surface tension of one liquid, and γ' is the surface tension of a reference liquid at the same critical difference temperature. A nomograph is developed from which the surface tension of any liquid at any temperature can be read off directly if the surface tension at two temperatures is known. A.

532.613 : 532.7 3142

The surface tension of liquid metals. SKAPSKI, A. S. *J. Chem. Phys.*, **16**, 389–93 (*April*, 1948).—The view is expressed that the main cause of the surface tension of all liquids, whether metallic or not, is the same, viz. the total surface energy is determined by the amount of energy required to bring the molecules or atoms (and electrons) from the bulk of the liquid to its free surface while enlarging the surface area. In organic liquids showing no dipoles this energy can be calculated directly from the heat of vaporization at absolute zero and from the configuration of nearest neighbours. In the case of metals, the change of kinetic energy of electrons must be considered in addition. Liquid metals show lower surface energies than might be expected from their heats of vaporization and from the configuration of their nearest neighbours. A short review of the recent electron theories of the surface tension of liquid metals is given. A.

532.613.096 : 532.7 3143

The temperature coefficient of the surface tension of liquid metals. SKAPSKI, A. S. *J. Chem. Phys.*, **16**, 386–9 (*April*, 1948).—From simple assumptions about the symmetry of configuration of the nearest neighbours the entropy change connected with bringing up atoms from the bulk of the liquid into its free surface is estimated, and from this the temperature coefficient of the surface tension is calculated. The experimental data lie well within the calculated limits. The influence of the thermal expansion is discussed. A.

532.613.4 : 541.183 = 4 *see Abstr.* 3493

532.614.2 3144

Calculation of the surface energy of liquid argon and mercury. JURA, G. *J. Phys. Coll. Chem.*, **52**, 40–7 (*Jan.*, 1948).—An equation for the surface energy of a liquid is set up in terms of the potential function, distribution function, and molal volume. By an appropriate approximation of the limits of the bulk distribution function, it is possible to use the distribution function determined in the interior of the liquid, which, applied to liquid A and Hg, yields values for the surface energy of 32 and 500 ergs cm^{-2}, respectively. These are comparable to the observed values of 35 and 525 ergs cm^{-2}. From the calculations it is found that 99% of the surface energy is to be found within 4 molecular diameters of the surface and that 78% of the effect is in the first layer. At low temperatures the surface energy should vary with temperature in approximately the same manner as energy of vaporization. This means that when the vapour pressure is low, for most liquids the derivative of the surface tension with respect to the temperature should be ~zero. This is in accord with most measurements. A.

532.694 3145

The degree of dispersion of the gas phase in foam. CLARK, N. O., AND BLACKMAN, M. *Trans. Faraday Soc.*, **44**, 1–7 (*Jan.–Feb.*, 1948).—The specific surface of a foam is defined and its change investigated over a period of time. The mechanism of the change appears to be a transfer of gas from a high pressure small bubble to a low pressure large one. A theory of this process is presented, and confirmed by measurements of individual bubbles in a foam atmosphere and by the substitution of gases other than air. A.

532.694 : 535.345 3146

The transmission of light through foam. CLARK, N. O., AND BLACKMAN, M. *Trans. Faraday Soc.*, **44**, 7–13 (*Jan.–Feb.*, 1948).—The relation between specific surface and loss factor for foams prepared from a non-absorbing solution was investigated. For such solutions a simple method of obtaining the specific surface of a generated foam is available. Absorbing solutions present a more complex problem, and it appears desirable to attempt the choice of a light wavelength suffering little absorption by the liquid. The method in its present form can be used as a means of specific surface measurement with suitable calibration when the foams are generated from absorbing solutions. A.

532.694 : 537.311 3147

The electrical conductivity of foam. CLARK, N. O. *Trans. Faraday Soc.*, **44**, 13–15 (*Jan.–Feb.*, 1948).—The electrical conductivity ratio between a foam and its generating solution was measured for a variety of foams, and the relationship with density ratio determined. It appears to be independent of the nature of the foaming agent and of the specific surface of the foam and the conductivity ratio may therefore be used as a measure of the density ratio. A.

532.694.1 3148

On the transformation of "solid" foam to a "fluid" foam under shear. BLACKMAN, M. *Trans. Faraday Soc.*, **44**, 205–6 (*April*, 1948).

KINETIC THEORY OF LIQUIDS 532.7

532.7 : 531.19 3149

Statistical mechanics of mixtures of Bose–Einstein and Fermi–Dirac systems. BAND, W. *J. Chem. Phys.*, **16**, 343–52 (*April*, 1948).—Full quantum corrections are applied to Mayer's recent extension of statistical thermodynamics to the multi-component liquid phase. In the case of Bose–Einstein systems, the theory predicts a typical λ-point condensation in momentum space. A Fermi–Dirac isotopic component dissolved to small concentrations in a Bose–Einstein liquid phase, like He_3 in He_4, is shown to behave to a first approximation independently of the Bose–Einstein degeneracy of the solvent at all temperatures above the λ-point. The theory appears unable to handle the situation below the λ-point. A.

532.7 : 532.613 *see Abstr.* 3142

532.7 : 532.613.096 *see Abstr.* 3143

532.7 : 534.845 : 534.321.9 *see Abstr.* 3193

532.7 : 536.7 3150

Thermodynamics of the system benzene–biphenyl. TOMPA, H. *J. Chem. Phys.*, **16**, 292–302 (*April*, 1948).—The vapour pressure of benzene and the heat of dilution of benzene-biphenyl mixtures were measured at 25°C. The results are in fair agreement with Guggenheim's formulae based on the lattice model, assuming that the biphenyl molecule occupies twice the volume of th benzene molecule, and that the co-ordination number the lattice is between 6 and 12. No agreement can b obtained if the effect of the different sizes is neglecte The experimental results of other authors are criticall examined and shown to conform to the above picture.

532.72 315

A diffusion problem in which the amount of diffusin substance is finite. IV. Solutions for small values of th time. CRANK, J. *Phil. Mag.*, **39**, 362–76 (*May*, 1948).— For previous work see Abstr. 2745 (1948). There a singularity in the solution at time $t = 0$, and th finite difference approx. used previously, is poor fo small t. Solutions are now developed, for small t, fo both linear and non-linear absorption. Diffusion in plane sheet, and in a circular cylinder, is considere Numerical examples are given, and the range of value of t for which each solution is applicable is considered. L. S. C

532.72 : 533.15 = 3 *see Abstr.* 3155

532.72.08 315

A cell for the measurement of diffusion in aqueou solution. GAGE, J. C. *Trans. Faraday Soc.*, **44**, 253– (*April*, 1948).—A diffusion cell is described which simple to construct and operate; it uses filter-paper as th diffusion membrane. The diffusion coefficients c glucose and sulphaguanidine obtained with this cell a in good agreement with the results obtained with th sintered glass-cell. The standard error of the mean c 6 experiments $\simeq 1 \cdot 5\%$.

532.73.2 315

The solubility of water in hydrocarbons. BLACK, C JORIS, G. G., AND TAYLOR, H. S. *J. Chem. Phys.*, **1** 537–43 (*May*, 1948).—The method in which H_2^3O act as a tracer in the determination of water solubility wa used for the measurement of the solubility in a number c paraffinic, olefinic, and diolefinic hydrocarbons. Th effect of temperature, pressure, size of hydrocarbo molecule, and the constitutive factors were studie Solubilities were determined in the temperature rang from 5° to 30°C at pressures from 1 to 6 atmos.

532.74 : 535.37 *see Abstr.* 3255

532.77 : 535.371 *see Abstr.* 3262

532.78 : 548.51 = 82 *see Abstr.* 3519

532.782 : 536.421.4 315

Water at −72°. RABEL, G. *Science*, **107**, 567 (*May* 2 1948).—See Abstr. 852 (1948). By repeatedly freezin and melting a drop of water, the freezing nuclei can b rendered inactive, and the drop could eventually be kep liquid down to −72°C.

MECHANICS OF GASES 533

533.15 : 532.72 = 3 315

The diffusion thermo-effect. II. WALDMANN, L *Z. Phys.*, **124** (*Nos* 3–6) 175–95 (1948) *In German.*— (1) Extension of the theory of the diffusion thermo-effe [Abstr. 401 (1946)] to gas mixtures of more than monatomic components. (2) Calculation of the effect i liquids, where it is very low because of the smallness c the ratio of diffusion constant to thermal diffusivity (3) Calculation of the temperature time-integral and th asymptotic approach of temperature to equilibrium i cylindrical diffusion chambers. These quantities ar required for the experimental determination of the therma diffusion coefficient and the ordinary diffusion coefficien from measurements of the diffusion thermo-effect [Abstr 2803 (1946), 3084 (1947)]. H. L

533.17 : 532.525 : 536.711 3156

Adiabatic flow of hydrogen gas through a rocket nozzle with and without composition change. PENNER, S. S., AND ALTMAN, D. *J. Franklin Inst.*, **245**, 421–32 (*May*, 1948).—The method of calculation is illustrated for the expansion of pure hydrogen gas from a chamber temperature of 3 506°K and a pressure of 20·42 atm. to atmospheric pressure. The exhaust velocity and temperature are highest for flow where complete equilibrium is reached at each temperature with respect to the reaction $H_2 \rightleftarrows 2H$. Flow with composition change requires a nozzle exit to nozzle throat area ratio somewhat greater than that determined for adiabatic flow without composition change for the same ratio of chamber pressure to exit pressure. The residence time in a given temperature range is computed as a function of gas temperature for the two types of flow. The results of this calculation may be used to determine the minimum required reaction rates which allow composition changes during flow through the nozzle. A.

533.275 : 551.508.71 *see Abstr.* 3548

533.5 3157

A high vacuum valve. LOCKENVITZ, A. E., HUGHES, D. S., LIPSON, L. B., AND OLEWIN, G. H. Letter in *Rev. Sci. Instrum.*, **19**, 272–3 (*April*, 1948).

533.5 3158

Design of high vacuum systems. Theoretical and practical considerations. NORMAND, C. E. *Industr. Engng Chem.*, **40**, 783–7 (*May*, 1948).—The basic formulae for the flow of gases at low pressures through pipes and apertures are reduced to forms readily applicable to the problem of vacuum system design. Methods are indicated for evaluating the conductance of channels of the more complex shapes commonly encountered in industrial systems. Factors limiting the applicability of the various methods are indicated, and the degree of accuracy attainable is compared with the accuracy required in design calculations. A.

533.5 3159

Measurement and control of leakage in high vacuum systems. JACOBS, R. B. *Industr. Engng Chem.*, **40**, 791–4 (*May*, 1948).—The use of the mass spectrometer forms the basis for the newer techniques here described.

533.5 3160

Measurement and comparison of pumping speeds. DAYTON, B. B. *Industr. Engng Chem.*, **40**, 795–804 (*May*, 1948).—A study has been made of the effect on measured pump speeds of varying the position of the mouth of the gauge, the position of the air inlet, the shape and size of the testing dome or head, and the design of the burette, ion gauge, and other measuring instruments. Various techniques of speed measurement are described and the common errors pointed out. The formulae for pumping speed are reviewed and the relation $1/S = 1/S_0 + 1/U$ for computing net pumping speed S at the end of a pipe of conductance U is shown to be incorrect for short lengths of pipe when the pump speed S_0 is measured with a test dome in the usual way. The need for improved standards is shown by comparison of speed curves and other data obtained by different laboratories for the same pump and by a review of the literature on measurement techniques. (32 refs.) A.

533.5 : 541.183 3161

Surface phenomena useful in vacuum technique. APKER, L. R. *Industr. Engng Chem.*, **40**, 846–7 (*May*, 1948).—Studies of surface phenomena can give valuable information at pressures so low as to be unmeasurable by the usual methods. Previous work on thermionic emission from wires, and on field emission from single crystals, is mentioned briefly. The photoelectric emission from W is very sensitive to residual gas in vacuum systems and can be used to estimate partial pressures of active gases. A simpler method involving a sudden burst of adsorbed gas into an ionization gauge is also described. A.

533.56 3162

The pumping speed of an oil diffusion pump for hydrogen. GIBSON, R. J., JR. Letter in *Rev. Sci. Instrum.*, **19**, 276–7 (*April*, 1948).—The measured speed of a 4-in horizontal, self-fractionating, steel, silicon-oil diffusion pump for H_2 is reported to be $1/3 \times$ that for air, instead of the theoretical $\sqrt{(2/29)}$. S. W.

533.56 : 539.181 *see Abstr.* 3456

533.59 3163

Design of high vacuum engineered plants. WEINGARTNER, H. C. *Industr. Engng Chem.*, **40**, 780–2 (*May*, 1948).—The design, installation, and maintenance of any industrial high vacuum system depend upon establishing and preserving a functional and economic balance among the following factors: working pressure, rate of evacuation, rate of leak, and rate of gas or vapour evolution. The interrelation of these general factors, as applied to several vacuum systems, is discussed in terms of practical experience. A.

533.6.01 : 532.513.032 3164

Erratum: On the one-dimensional theory of steady compressible fluid flow in ducts with friction and heat addition. HICKS, B. L., MONTGOMERY, D. J., AND WASSERMAN, R. H. *J. Appl. Phys.*, **19**, 523 (*June*, 1948).—See Abstr. 258 (1947).

533.6.011.31 : 536.27 : 532.517 = 82 *see Abstr.* 3133

533.6.011.5 = 4 3165

On the transition beyond the speed of sound in a gas current. VULIS, L. A. *C.R. Acad. Sci. URSS*, **54** (*No.* 8) 665–8 (1946) *In French.*—A general equation is written down, showing the variation in velocity of a gas current in a tube with variation in the cross-section of the tube, or with the supply of gas, or heat, or the work of dilatation of the gas (turbine effect). On the basis of this equation, a study is made of 4 methods by which the velocity may be made to exceed that of sound. Variation of the density, pressure, temperature, etc., is also calculated. L. S. G.

533.6.011.6 : 536.244 3166

Air turbulence and transfer processes. Flow normal to cylinders. COMINGS, E. W., CLAPP, J. T., AND TAYLOR, J. F. *Industr. Engng Chem.*, **40**, 1076–82 (*June*, 1948).—The turbulence level of an air stream flowing through an 11-in square duct was varied from 1 to 20% by placing one of several different grid type turbulence generators in the stream. The turbulence level was measured by a hot wire wake angle thermal diffusion device placed upstream from an experimental cylinder which was normal to the direction of air flow. These measurements were used to calculate the turbulence levels at the position of the cylinder, and these values were compared with heat and mass transfer rates from the cylinder over a range of Reynolds numbers, based on the cylinder diameter, from 400 to 20 000, all in the turbulent flow range. It was found that increased turbulence at a constant Reynolds number caused a maximum of 25% increase in the rate of heat transfer. The transfer rates were augmented by increased turbulence at larger Reynolds numbers, but this effect was negligible at smaller Reynolds numbers. In the range of Reynolds numbers tested, baffles arranged to increase the local velocity near the cylinder were more effective in increasing the transfer rate than were those arranged to increase only the level of turbulence. A.

KINETIC THEORY OF GASES 533.7

533.7 : 535.338.334 : 538.615 : 535.343.4–14 *see Abstr.* 3250

533.75 : 536.71 : 541.126 3167

An equation of state for gases at high pressures and temperatures from the hydrodynamic theory of detonation. Cook, M. A. Letter in *J. Chem. Phys.*, **16**, 554–5 (*May*, 1948).—Reply to Paterson's criticism [Abstr. 1176 (1948)].

VIBRATIONS . ACOUSTICS 534

534.01 3168

Self-excited mechanical oscillations. Minorsky, N. *J. Appl. Phys.*, **19**, 332–8 (*April*, 1948).—A study of the phenomenon of self-excitation in an electromechanical system. This phenomenon is expressible in terms of a difference-differential equation, having a frequency spectrum that depends on a parameter. The linear theory fails to give an answer to the question of stability of oscillations. It is necessary for this purpose to make use of the equations of the first approximation of the non-linear theory. Expressions for a stable stationary amplitude and frequency obtained on that basis show an agreement with the observed features of these self-excited oscillations. A.

534.01 : 530.145 = 3 3169

A general theory of non-degenerated oscillations. Lippert, W. *Elektrotechnik, Berlin*, **2**, 113–20 (*April*, 1948) *In German.*—The solution of "non-degenerated" oscillation equations contain terms of form $(1+\alpha t/T_0)^{-1/\alpha}$; where t = time, T_0 = time constant, $1/\alpha$ = "degeneration constant." When $\alpha \to 0$ the terms degenerate into ε^{-t/T_0}. Non-degenerated oscillations ($\alpha \neq 0$) are examined; they are a more general case of exponential or degenerated oscillation. The concept of complex time is introduced, and the case of pure imaginary time treated. The complex differential equations obtained are split into real and imaginary components and solved simultaneously. The resemblance between the coefficients of non-degenerated diff. equations and the experimentally observed dimensionless constants of the microcosmos is pointed out. It may be possible to derive a non-degenerated wave equation by the methods given. V. W. R.

534.121.1 3170

Thickness-shear vibrations of thin anisotropic plates. Hok, G. *J. Acoust. Soc. Amer.*, **20**, 406–17 (*July*, 1948).—The vibrational boundary conditions of a free, thin, rectangular, plane-parallel plate can be satisfied by the sum of an infinite series of plane wave components. When the ratios of the thickness to the length and width of the plate are small, this series converges rapidly enough to give a fair approximation with a reasonable number of terms. Frequency spectra as well as standing-wave configurations are calculated approximately for *AT* and *BT* cut quartz plates. Some observed data are given for comparison. A.

534.133 : 535.417 3171

Application of multiple-beam interferometry to the study of oscillating quartz crystals. Tolansky, S., and Bardsley, W. Letter in *Nature, Lond.*, **161**, 925 (*June* 12, 1948).—The fringes formed by interference between the (slightly curved) silvered surface of the crystal and an optical flat are broadened when the crystal is oscillating, the distribution of oscillation amplitude over the surface of the crystal being plainly seen. The nodal points appear to remain stationary within 50 Å.

534.141.2 = 3 3172

Theory of the origin of impact sounds. Cremer, H., and Cremer, L. *Frequenz*, **3**, 61–71 (*March*, 1948) *In German.*—A simplified system to demonstrate the initiation of impact sounds (*a*) on a stretched string and (*b*) on an infinite plate is described. The kinematical problem of the wave system radiating from a point source of alternating pressure on a plate is discussed and an expression for the mechanical resistance of the plate is derived. The spectrum of the impact sound is investigated. Consideration is given to the practical case of a plate of finite dimensions and to the effect of a cushion layer on the plate. A. B. W.

534.213 : 534.321.9 3171

Measurement of ultrasonic bulk-wave propagation in high polymers. Nolle, A. W., and Mowry, S. G. *J. Acoust. Soc. Amer.*, **20**, 432–9 (*July*, 1948).—The velocity and attenuation of bulk waves (longitudinal waves of dilatation) in solid samples of high polymers are measured by an acoustic pulse technique in the frequency range 10 to 30 mc/s. An ultrasonic pulse of about 2 μsec duration is transmitted by a crystal into the liquid contained in a tank about 5 cm long, and returned as an echo to the crystal transducer. The velocity of bulk waves in the polymeric material is found from the change in echo arrival time which occurs when a flat sample is introduced into the sound path, and the attenuation is found from the reduction of echo intensity. Measurements for several rubbers and plastics are reported over various portions of the temperature range −60°C to 100°C. The attenuation generally shows at least one maximum with respect to temperature in this range. Maximum attenuation values for various rubbers at 10 mc range from 200 to 400 db/cm.

534.213–14 : 534.24–16 3172

Example of propagation of underwater sound by bottom reflection. Young, R. W. *J. Acoust. Soc. Amer.*, **20**, 454–62 (*July*, 1948).—From data obtained in study of underwater sound propagation, eight examples at 200 c/s have been selected to illustrate long-range propagation involving reflection from the ocean bottom. Essentially continuous sound measurements were made while the sending vessel moved from 100 m to 60 km or more away from the receiver. The source was at a depth of 4·3 m, the receiver usually at 5, 15 or 90 m. For the examples given the water depths were 3 600, 1 800 and 95 m respectively and with some variety of thermal conditions. There is some evidence of interference extrema. In 3 600 m water the bottom-reflected signals were roughly constant to 10 km, partly because in water of this depth the distance to and from the reflecting bottom does not change rapidly with increasing horizontal range. In an extreme case the bottom-reflected signal was about the same at ranges of 3 and 60 km, and it was about 15 db higher than this value at a range of 10 km.

534.213.4 3173

On the radiation of sound into a circular tube. Ingard, V. *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 70, 48 *pp.* (1948) *In English.*—A comprehensive theoretical investigation of the radiation of sound into a tube of circular section from sources of circular symmetry. Of these sources a plane piston is selected for special consideration. Detailed treatment is given for special values of the terminal impedance of the tube; pressure distributions, radiation impedances, illustrated by equivalent circuits, are calculated. Application of the theory to the case of a cylindrical resonator is made resulting in a modification of the usual formula for the resonance frequency. A. B. W.

534.213.4 3174

Theoretical analysis of the mercury delay line

McSkimin, H. J. *J. Acoust. Soc. Amer.*, **20**, 418–24 (*July*, 1948).—A mathematical expression for the pressure distribution in a circular Hg delay line is derived. It is found that many waves having slightly different phase velocities can exist, and under certain circumstances may interfere with each other to produce distortion effects. An analysis is made of the voltage developed by the piezoelectric pick-up crystal, and of the distortion that might result when the carrier is pulse-modulated. A.

534.213.4 = 4 3177

Propagation of sound in capillary tubes. Nief, G. *C.R. Acad. Sci., Paris*, **223**, 306–8 (*Aug.* 12, 1946) *In French.*—The equations of propagation, incorporating terms describing the damping due to viscosity and heat changes, are written down and expressions are found for the resulting velocity of propagation and damping coefficients. Experiments supporting the accuracy of these formulae are briefly described. L. S. G.

534.213.4 : 534.321.9 3178

On ultrasonic propagation through mercury in tubes. Huntington, H. B. *J. Acoust. Soc. Amer.*, **20**, 424–32 (*July*, 1948).—Some measurements have been made of the attenuation of ultrasonic waves in Hg as a function of tube diameter and the inner surface of the tube. A pulse technique was employed and attenuation was measured at 10·6 Mc/s by comparing successive echoes of the initial pulse. The results with smooth glass tubes are in qualitative (although not quantitative) agreement with the predictions of the Helmholtz theory for tubes large compared with the wavelength. A.

534.22 : 534.845 *see Abstr.* 3207

534.222.2 3179

The head-on collision of a shock wave and a rarefaction wave in one dimension. Moses, H. E. *J. Appl. Phys.*, **19**, 383–7 (*April*, 1948).—A procedure for investigating the strengthening of the shock wave is suggested and carried through for the case in which the entropy jump across the shock is small enough to be negligible. A.

534.222.2 3180

Shock waves in air at very high pressures. Davies, D. R. *Proc. Phys. Soc., Lond.*, **61**, 105–18 (*Aug.*, 1948).—The equations of the shock wave in air at n.t.p. are solved numerically for pressures on the high pressure side up to 1 000 atm. The solution enables all the physical entities, such as temperature, wave velocity, particle velocity, air density, etc., on the shock wave front to be expressed numerically as a function of the wave pressure. To solve these equations it is necessary to know the internal energy (E) and volume (v) of one gramme of air over certain regions of the two-dimensional range $1 < p < 1\,000$ atm. and $273 < T < 16\,000$°K. Calculations are carried out to assess the numbers of the various types of molecules, atoms and ions present at any p and T. The only E values needed at high p are those for which T is also high, and the simple gas laws may therefore be assumed for the volume determinations. Statistical mechanics furnishes equations whose solution fixes the composition. This set of equations is difficult to solve to any degree of accuracy if oxides of nitrogen are taken into account. As a first approximation, the shock wave equations are worked out on the assumption that the species present are N_2, O_2, N and O. These calculations make full allowance for all quantum states apart from ionic states. They are refined later by taking into consideration the presence of NO and argon (1·3% by weight) and ionization possibilities. A.

534.222.2 : 534.24 3181

The reflection of a plane shock wave at a gaseous interface. Paterson, S. *Proc. Phys. Soc., Lond.*, **61**, 119–21 (*Aug.*, 1948).—A plane shock wave falls normally on the interface between two ideal gases of molecular weights M, m and constant ratios Γ, γ of specific heats. As a rule, the character of the reflected wave then depends only on the ratio $\Gamma M/\gamma m$. In exceptional cases, however, the type of reflection may change at a critical value of the incident intensity. An example of this is given. A.

534.222.2 : 541.126 3182

Energy partition in underwater explosion phenomena. Arons, A. B., and Yennie, D. R. *Rev. Mod. Phys.*, **20**, 519–36 (*July*, 1948).—Pressure-time curves, continuous from initial shock wave incidence through the second bubble pulse, are examined in the light of acoustic theory. Calculations of impulse and reversible and irreversible energy flux are made for the various phases of the phenomenon. An estimate has been made of the amount of energy dissipation associated with the propagation of the shock front. A tabulation of the energy partition is included, and it is shown that substantial quantities of energy are radiated or dissipated by mechanisms other than these taken into account in this discussion. A.

534.23 : 534.78 *see Abstr.* 3201

534.231.2 : 534.232 3183

The directional characteristics of a clamped-edge disk. Merrill, L. L., and Slaymaker, F. H. *J. Acoust. Soc. Amer.*, **20**, 375–80 (*July*, 1948).—To obtain very small side lobe radiation the amplitude distribution across a radiating surface should be such that the maximum amplitude is at the centre and the minimum at the edges. The Gaussian distribution gives no side lobes, but requires an infinitely large radiator. The clamped-edge disc, vibrating in its first normal mode, has a dynamic curve approximating the Gaussian form and a sound pressure distribution with very small side lobes, the amplitude of the first side lobe being 33 decibels below that of the axial lobe. For a disc of a given diameter the width of the axial lobe may be decreased by raising the frequency of the first normal mode, which requires a corresponding increase in the disc thickness. At very high frequencies the disc thickness may become prohibitive. In such cases a thin disc can be forced to vibrate in the shape of the first normal mode by a proper radial distribution of the driving force. A.

534.232 3184

Calculation of the directivity index for various types of radiators. Molloy, C. T. *J. Acoust. Soc. Amer.*, **20**, 387–405 (*July*, 1948).—The "directivity index" is defined as "the ratio of the total acoustic power output of the radiator to the a.p.o. of a point source producing the same pressure at the same point on the axis." The utility of the d.i. concept is that it permits power calculations to be made for all radiators in the same manner as for point sources. D.i. formulae, together with graphs covering practical cases, are given for the following types of radiators: (1) General plane piston in infinite baffle; (2) Circular plane piston in infinite baffle; (3) Rectangular plane piston in infinite baffle; (4) Sectoral horn; (5) Multicellular horn; (6) Piston set in sphere. A.

534.232 : 534.231.2 *see Abstr.* 3183

534.232 : 621.317.39 : 531.76 *see Abstr.* 3120

534.232 : 621.392.51 : 621.395.61 3185

Substitution method for calibrating a microphone. Madella, G. B. Letter in *J. Acoust. Soc. Amer.*, **20**, 550–1 (*July*, 1948).—The writer makes an important generalization of the special case considered by Cook [Abstr. 2806 (1947)].

534.24 : 534.222.2 *see Abstr.* 3181

534.24–14 3186

Reflection of underwater sound from the sea surface. LIEBERMANN, L. N. *J. Acoust. Soc. Amer.*, **20**, 498–503 (*July*, 1948).—Information on the instantaneous sea surface reflectivity for 30 kc sound has been obtained. The method required that the submerged source and receiver be rigidly mounted on towers resting on the sea bottom. Transmission of a frequency-modulated sound pulse results in an interference pattern at the receiver; interference occurs between the direct and reflected sound. Analysis of these interference patterns reveals the following: The average time of persistence of the pattern is $\frac{5}{100}$ of a second. Under the conditions of the experiment, surface reflectivity is highly frequency dependent. The median value for the reflection coefficient is near to unity. Approximately 10% of the time the sea surface focuses the sound, giving a reflection coefficient > 1. A.

534.24–16 : 534.213–14 *see Abstr.* 3174

534.241–14 3187

Reverberation in the sea. EYRING, C. F., CHRISTENSEN, R. J., AND RAITT, R. W. *J. Acoust. Soc. Amer.*, **20**, 462–75 (*July*, 1948).—The apparatus used to measure ocean reverberation at 24 kc/s consists essentially of a sound projector which sends a signal of adjustable duration into the water; a hydrophone which translates the backward scattered sound into electrical voltage; an amplifier which increases this voltage; a cathode-ray oscillograph which converts voltage fluctuations into spot movements; and finally a camera which records the movements on a moving film. At certain times and under certain conditions, presumably when ocean conditions are those postulated by theory, observed reverberation levels agree with theoretical values. Such agreement, however, is relatively uncommon. Under most conditions, deep scattering layers cause volume reverberation levels to depart markedly from simple theory; also, a combination of refraction, wind, and other factors causes a decrease in surface reverberation level with range which is too rapid to be in agreement with simple theory. When a sound beam is projected horizontally in deep water, both surface and volume reverberation might be expected. Under a rough sea and for ranges less than 500 yards, surface reverberation predominates over volume reverberation. Beyond 1 000 yd, even under a rough sea, volume reverberation usually overshadows surface reverberation. Also, for such long ranges, attenuation causes the reverberation level to fall off more rapidly than the rate predicted by simple scattering. In shallow water, bottom reverberation is the dominant part of the observed reverberation. •A.

534.26 3188

Notes on sound diffraction by rigid circular cones. WIENER, F. M. *J. Acoust. Soc. Amer.*, **20**, 367–9 (*July*, 1948).—A stationary right circular cone was exposed to an essentially plane progressive wave, and the sound pressure p at various points on the surface was determined relative to the free-field pressure p_0 in the undisturbed incident wave. Measurements were made in the frequency range of $\frac{1}{4} < ka < 8$, where k is the wave number of the incident wave and a the radius of the base of the cone which had a generating angle of 30°. In particular, the diffraction effect $|p/p_0|$ was determined at the centre of the base for various angles of incidence θ, measured with respect to the axis of the cone. The results are generally similar to those obtained for other obstacles with the same circular face, e.g. a disc. As might be expected, the greatest differences are exhibited in the region $\theta > 90°$. A "bright" spot appears at the centre of the base when the vertex points directly towards the source ($\theta = 180°$). For incidence normal to the base pressure measurements have been made at several other points on the surface of the cone. The data, represented as a function of frequency and position by a surface, give an approximate picture of the pressure distribution over the whole surface of the cone. A.

534.26 318

The diffraction of a sound wave by an infinite set of plates. MILES, J. W. *J. Acoust. Soc. Amer.*, **20**, 370– (*July*, 1948).—It is pointed out that a certain class of diffraction problems can be formulated as Wiener Hopf integral equations and solved exactly, an observation due to Schwinger [Abstr. 1168 (1947)]. Following the analysis of the equivalent electromagnetic problem by Carlson and Heins [Abstr. 71 (1948)], the diffraction of plane wave of sound by an infinite set of parallel equally spaced semi-infinite plates is calculated. The condition for plane wave propagation within the plates, for a single reflected wave, and expressions for the reflection and transmission coefficients are given. Except for the limitations by the requirements that only a plane wave be propagated and that there be only a single reflected wave the reflection and transmission coefficients are found to be independent of wavelength or the spacing between the plates. Other problems which may be solved by the same techniques are cited. A.

534.26 319

The diffraction of sound by circular disks and apertures. SPENCE, R. D. *J. Acoust. Soc. Amer.*, **20**, 380–6 (*July* 1948).—A rigorous theory of the diffraction of plane sound waves by circular discs and apertures is developed by use of oblate spheroidal co-ordinates. Numerical results for the cross-section for scattering and transmission are given in graphical form. A.

534.321.3 319

Melodic scales. VERMEULEN, R. *J. Acoust. Soc. Amer.*, **20**, 545–9 (*July*, 1948).

534.321.6 : 537.226.8 : 548.0 *see Abstr.* 3515

534.321.9 : 518.5 : 621.318.572 319

An ultrasonic memory unit for the EDSAC. WILKES, M. V., AND RENWICK, W. *Electronic Engng*, **20**, 208–1 (*July*, 1948).—Hg-delay lines combined with quartz crystal transducers are used [see Abstr. 559 (1948)]. The ultrasonic energy is derived from a 13·5 Mc/s oscillator, modulated by 0·9 μsec pulses at 2 μsec pulse intervals. The delay lines, arranged in batteries of 1 are ~64 in long and are each capable of holding 576 pulses or 16 "minor cycles" (numbers of 34 binary digits). The line construction involves exacting requirements and is described in detail. The associated gating circuits, amplifiers and oscillator are also described, together with short delay lines of capacities of $\frac{1}{2}$ and 1 minor cycles. H. G. M.

534.321.9 : 534.213 *see Abstr.* 3173

534.321.9 : 534.213.4 *see Abstr.* 3178

534.321.9 : 534.614 : 535.42 *see Abstr.* 3280

534.321.9 : 534.845 : 532.7 319

Absorption of ultrasonic waves in acetic acid. PINKERTON, J. M. M. Letter in *Nature, Lond.*, **162**, 106–7 (*July* 17, 1948).—Viscosity and heat conduction cause absorption $\propto$ (frequency, ν)^2; relaxation processes contribute additional absorption $\propto \nu$. For acetic acid, (absorption)/ν^2 plotted against $\log \nu$ becomes constant at 155×10^{-17} sec^2 cm^{-1} for high ν (100 Mc/s); if this is subtracted from the values at lower frequency, the relaxation absorption can be isolated, and is shown t

conform to Kneser's equation [Abstr. 3340 (1938)] for a process with relaxation time $\sim 5\times10^{-7}$ sec.

534.321.9 : 541.18.041 = 5 3194

Action of high-frequency sound vibrations on certain metallic systems having a limited miscibility. BARGONE, A., AND RINALDI, F. *Tecn. Ital.*, **3**, 57–64 (*March–April*, 1948) *In Italian.*—The apparatus described for producing h.f. sound vibrations is of the Schmid magnetostriction type, and consists of a water-cooled vertical Ni tube, which is subjected to a gradually increasing magnetic field in the direction of the lines of force of the field until resonance effects between the frequency of the field and the vibrations of the tube result. A crucible containing molten Zn was supported on the top of the tube, and Pb was added to it. After etching the surface of the solidified test-piece with 5% H_2SO_4, photographs of the position of the Pb–Zn separation layer were taken at intervals of up to 50 min. These show the gradual production of homogeneous dispersion of the Pb in the Zn; e.g. after 30 min of irradiation the Pb particles average 60 μ in diameter, and are homogeneously distributed in the Zn. Similar sets of photographs show the effect of adding 32% of Sn (Zn 23, Pb 60%). The work indicates that there is a dispersing effect depending on the exposure time and on the frequency and amplitude of the vibrations. A coagulation behaviour similar to that of a colloidal solution is indicated, and the mechanism of the process is discussed. J. G.

534.321.9 : 548.24 *see Abstr.* 3516

534.441.1/.2 : 534.78 *see Abstr.* 3202

534.442 : 534.785 *see Abstr.* 3203

534.511.2 : 535.33 *see Abstr.* 3224–5

534.611 3195

The response of a resonant system to a gliding tone. BARBER, N. F., AND URSELL, F. *Phil. Mag.*, **39**, 345–61 (*May*, 1948).—The response to a tone whose frequency slowly increases or decreases is examined theoretically. The result is useful in the construction of apparatus for frequency analysis [Abstr. 2855 B (1946)]. The form of the response is complicated, but variation of amplitude near resonance depends upon a single parameter involving the constants of the apparatus. An optimum value of the parameter gives the highest resolving power of the frequency analyser. Similar results hold when a tone of fixed frequency acts upon a resonant system whose natural frequency is slowly changed. L. S. G.

534.612 3196

A comparison of the Rayleigh disk and the acoustic radiometer methods for the measurement of sound-wave energy. HARTMANN, J., AND MORTENSEN, T. *Phil. Mag.*, **39**, 377–94 (*May*, 1948).—The aim of the comparison was to test whether the formula, $S = 2E$, or, $S = (K + 1)E$, (where $K = C_p/C_v$ is the ratio of the specific heats), for the pressure, S, of sound waves falling on a plane reflecting wall, is correct. Apparatus is described for making the test and the comparison shows that the first formula, $S = 2E$, is the one which must be taken. L. S. G.

534.612 3197

Sound pressure measurement equipment for the range 50 cycles to 250 kc. MASSA, F. *J. Acoust. Soc. Amer.*, **20**, 451–4 (*July*, 1948).—Describes a newly developed acoustic instrument now commercially available for making absolute sound pressure measurements over the frequency range 50 c/s to 250 kc/s. The microphone standard is only $\frac{1}{4}$ in diameter, and is therefore completely free of diffraction errors throughout the entire audible spectrum to beyond 20 kc/s. In order to maintain constant phase shift between the generated voltage and the actuating pressure, the vibrating system is stiffness-controlled to beyond 250 kc/s, thus insuring accurate reproduction of pressure wave transients having extremely steep wave fronts. The tiny size of the microphone and its very high acoustic impedance will permit free field measurements throughout the entire audible range, and well into the ultrasonic region, without diffraction errors. A preamplifier and power supply unit makes the equipment readily portable. A.

534.614 : 534.321.9 : 535.42 *see Abstr.* 3280

534.614 : 545.7 *see Abstr.* 3506

534.62–14 3198

Absorbing media for underwater sound measuring tanks and baffles. MASON, W. P., AND HIBBARD, F. H. *J. Acoust. Soc. Amer.*, **20**, 476–82 (*July*, 1948).—By using absorbing walls surrounding a small body of water, measuring tanks have been produced which will determine the directional properties of underwater sound instruments down to a level of 25 db below the direct beam. These absorbing media are constructed by inserting fine mesh screen or packed copper wadding in a viscous liquid such as castor oil and result in an enhanced viscous action which is nearly independent of the frequency above 10 kc/s. A six-inch wall can reduce the reflections by 20 db. Tanks using such absorbing media were used for testing transducers at the manufacturing plant and were used for determining the approximate characteristics of small sized instruments. Absorbing media were also used in the sound transparent dome housing the transducer and in the back of the QJB transducers. A.

534.642 3199

Acoustic impedance measurement of very porous screen. HARRIS, C. M. *J. Acoust. Soc. Amer.*, **20**, 440–7 (*July*, 1948).—A new procedure for the measurement of the normal specific acoustic impedance of extremely porous screen as a function of frequency. The method, restricted to this case, is based on a special application of the transmission-characteristic method of impedance measurement and can be applied to screens having impedances even less than $\frac{1}{100}$ the characteristic impedance of air. Relatively simple experimental equipment and computation is required. Measured values of the impedance for two samples of extremely porous screen, determined by this procedure, are given. A.

534.75 : 612.85 : 534.792 3200

The influence of interaural phase on interaural summation and inhibition. HIRSH, I. J. *J. Acoust. Soc. Amer.*, **20**, 536–44 (*July*, 1948).—The difference between the binaural and monaural thresholds varies within fairly large limits. Although this binaural-monaural difference does not vary as a function of frequency when pure-tone thresholds are measured in the quiet, the difference does vary with frequency when pure tones are presented against a background of noise. Binaural summation, a term indicating that the binaural threshold is lower than the monaural, obtains for masked thresholds only when the phase angles between the two earphones are opposite for the tones and the noise. If the tones and the noise have the same interaural phase angle the binaural threshold is higher than the monaural. This phenomenon, called interaural inhibition, as well as its antipode, interaural summation, is most marked at low frequencies and increases as the intensity of the masking noise is increased. The discussion considers some implications of these findings for the theory of masking and of interaural summation. A.

534.78 : 534.23 3201

Reaction of small enclosures on the human voice. II. Analyses of vowels. MORROW, C. T. *J. Acoust. Soc. Amer.*, **20**, 487–97 (*July*, 1948).

534.78 : 534.441.1/2 3202

Voice measurements with an audio spectrometer. RUDMOSE, H. W., CLARK, K. C., CARLSON, F. D., EISENSTEIN, J. C., AND WALKER, R. A. *J. Acoust. Soc. Amer.*, **20**, 503–12 (*July*, 1948).—The distribution of average power in various speech sounds as a function of frequency has been measured with an integrating audio spectrometer. This instrument divides the electrical signal into 14 frequency bands and simultaneously records the integrated square of the amplitude in each band over a measured time interval, usually 30 sec. The spectral distribution of average acoustic power at the location of the input microphone can then be computed. Speech spectra are given which are average results for a trained crew of seven men, speaking into a condenser microphone in an anechoic chamber. A.

534.785 : 534.442 3203

The representation of vowels and their movements. POTTER, R. K., AND PETERSON, G. E. *J. Acoust. Soc. Amer.*, **20**, 528–35 (*July*, 1948).—It is shown that movement of the major resonances in the voiced sounds of speech may be represented by traces in a three-dimensional graph. Apparently a great deal can be learned about speech through investigation of such traces, and they suggest a new method for vowel designation that is particularly adaptable to quantitative analysis. A.

534.791 3204

The loudness of repeated short tones. GARNER, W. R. *J. Acoust. Soc. Amer.*, **20**, 513–27 (*July*, 1948).—The relation between loudness and the repetition rate of short tones was experimentally determined. The effects of intensity, frequency, and tone duration on this relation were also studied. Results: (1) A series of repeated short tones can be louder than a steady tone of the same peak intensity; (2) The difference between the loudness of repeated tones and a steady tone of the same intensity is dependent on both frequency and intensity; (3) Two series of repeated tones, of the same frequency and intensity, will not have the same loudness unless their repetition rates and durations are the same. At high intensities, the tones with the faster repetition rate and shorter duration are louder, and conversely at low intensities; (4) The rate at which loudness increases with repetition rate is dependent on the duration. All of the relations shown are understandable in terms of the shape of the loudness function, and the complex spectra of repeated short tones. Loudness levels, according to Fletcher and Munson's method for calculating the loudness of multicomponent tones, agree very well with the observed ones. A.

534.792 : 612.85 : 534.75 *see Abstr.* 3200

534.84 = 3 3205

On the use of models in architectural acoustics. ORMESTAD, H. *K. Norske Vidensk. Selsk. Skr.* (*No.* 1) 35 *pp.* (1942) *In German.*—The paper deals with similar work in recent years published in American journals. It is mainly concerned with a study of the resonance frequencies of model rooms, the sound absorbent properties of materials used to cover the walls, and reverberation times. The equipment used in the investigations is described in some detail. A. B. W.

534.844.3 3206

The time integral basic to optimum reverberation time. MAXFIELD, J. P. *J. Acoust. Soc. Amer.*, **20**, 483–6 (*Ju* 1948).—Equations showing the relation between t volume, V, of an auditorium and its optimum reverber tion time, T_0, were published independently by MacNa and Lifschitz based on the following assumption $\int_0^{T_1} (\log \rho) dt = a$ const., E = const., where ρ = i stantaneous value of the energy density of sound duri decay, T_1 = time of decay to minimum audibilit E = rate of supply of energy during the steady sta condition. This paper shows that an equation, relati T_0 and V, can be deduced which more nearly fits all t empirical facts by basing the derivation on the followi assumptions: $\int_0^{T_1} \rho \, . \, dt = a$ const., $E = GV^n$, whe G = a constant, n = a constant < 1. The resulti equation for $n = \frac{2}{3}$ is $T_0 = 0{\cdot}212\ V^{1/6}$. This is in agre ment with the empirical data and with the equatio derived by Maxfield and Albersheim from acoust "liveness" considerations.

534.845 : 532.7 : 534.321.9 *see Abstr.* 3193

534.845 : 534.22 320

Sound absorption and velocity in liquefied argo oxygen, nitrogen, and hydrogen. GALT, J. K. *J. Chem Phys.*, **16**, 505–7 (*May*, 1948).—The pulse method w used to measure the velocity and absorption of sound liquefied A, O_2, N_2, H_2 at 44·4 Mc/s. The expe mentally determined attenuation, α, is compared wi the calculated attenuation due to viscosity, α_{vis}, and t results indicate that relaxation processes are not a important mechanism for sound absorption in any these gases, except perhaps for H_2. Measurements we also made at 14·8 Mc/s, but the attenuations were t low for satisfactory precision. Indications, however, a that the attenuation $\propto$ (frequency)^2.

534.85 : 621.395.614 320

A single shear plate crystal phonograph pick-u WIGGINS, A. M., AND LEWIS, F. S. *J. Acoust. So Amer.*, **20**, 448–50 (*July*, 1948).—A method of driving single shear plate crystal through a mechanical tran former is described. Particular attention is paid to t application of this drive to a phonograph pick-up. T advantages of this method of drive over previous metho are discussed.

534.861.1 : 621.396.712.3 320

The acoustical planning of broadcasting studio MCLAREN, J. *B.B.C. Quart.*, **1**, 194–208 (*Jan.*, 1947).- The principles of sound insulation and correction a outlined, the specification of suitable insulating partitio being given and the layout of studios within a buildi discussed. Particular reference is made to the sou insulation of doors. The use of absorbing materials a resonant panels for reducing the reverberation time described and also new methods of obtaining lo frequency absorption. Results of tests to ascertain t effects of introducing various elements into a studio a given. The greater importance of reverberative effe compared with reverberation time, is stressed. G. F.

534.861.1 : 621.396.712.3 321

Acoustic problems in studio design. NIXON, G. M *Electronics*, **21**, 86–9 (*May*, 1948).—The insulation new buildings from external sounds and vibrations a the adaptation of space in existing buildings otherwi devoted to various noisy activities are considere Recommendations for the construction of walls, floo ceilings and wall openings are given and the essenti precautions required in connection with ventilati

systems specified. Floor covering and furnishings for various types of studios are discussed. H. G. M. S.

OPTICS . RADIATION . SPECTRA 535

535.14 : 612.84 *see Abstr.* 3049

535.215 : 621.383 = 3 3211

The multi-layer photocell. MAYER, H. *Z. Phys.*, **124** (*Nos* 3–6) 345–7 (1948) *In German.*—[Abstr. 2769 B (1948)].

535.215.2 : 539.233 = 3 3212

The photo-electric properties of alkali-layers of atomic thickness. MAYER, H. *Z. Phys.*, **124** (*Nos* 3–6) 326–44 (1948) *In German.*—Experiments were carried out on alkali metal layers of known thickness in order to determine the quantum efficiency of the photo-electric effect at various wavelengths (2 500–6 500 Å), and thereby to separate its surface and volume components. For layers of sub-atomic thickness (incomplete coverage) the quantum efficiency ∝ thickness at all wavelengths. As the layers become thicker, the efficiency for small wavelengths increases less rapidly. Layers of two or more atoms thickness behave already as the solid material, and the effect is shown to depend only on the metal surface. The quantum efficiency for longer wavelengths passes through a maximum value when the layers are nearly monatomic. The results are in agreement with de Boer's theory concerning changes in the energy of ionization as a result of adsorption. H. K. H.

535.215.4 : 538.632 : 537.323 = 3 *see Abstr.* 3346

535.23.08 : 535.39 *see Abstr.* 3276

535.231.4 = 4 3213

The influence of the state of the surface of a radiating material on the value of its emissivity at high temperature. MICHAUD, M. *C.R. Acad. Sci., Paris*, **226**, 568–9 (*Feb.* 16, 1948) *In French.*—Formulae for the emissivity of a radiating surface, considered to consist of a number of cavities separated by smooth portions of the surface, are stated. Lambert's law was obeyed by the majority of the refractory brick specimens examined, and microphotographs of the surfaces showed that they consisted entirely of contiguous cavities. The monochromatic and total emissivities of cylindrical specimens with an axial hole were measured. The brilliancy and radiation temperatures were always found to be linear functions of the true temperature for 1 000 to 1 500°K. The values for two coke furnace brick specimens for red, green and white radiations are given. S. W.

535.231.4 : 621.38.032.216 : 537.583 *see Abstr.* 3371

535.24 : 531.72 = 3 *see Abstr.* 3119

535.242.62 : 535.736.14 *see Abstr.* 3289

535.242.62 : 612.84 = 82 *see Abstr.* 3050

535.243 = 3 3214

Integrated radiation measurements with a monochromator. HERRMANN, R. *Optik*, **2**, 384–95 (*Oct.–Nov.*, 1947) *In German.*—The light from a large solid angle of, e.g., the sky enters an integrating sphere, and the light leaving a small aperture in the sphere enters a double monochromator; its intensity is there measured, wavelength by wavelength, with a gas-filled emission photocell and amplifier. The spectral distribution of the light from the sky, with or without sunlight, and that from certain sources used for u.v. irradiation has been measured and the results are given. J. W. T. W.

535.245.24 : 621.325.17 : 535.89 *see Abstr.* 3293–4

535.31.08 = 4 3215

Perfecting optical benches. CALVET, E. *Rev. Opt. (Théor. Instrum.)* **27**, 245–8 (*April*, 1948) *In French.*—Improved bench and carriers are described allowing many independent adjustments.

535.312 = 3 3216

Deviating properties of inclined mirrors. GÜNTHER, N. *Optik*, **2**, 382–3 (*Oct.–Nov.*, 1947) *In German.*—The deviation of a ray in the principal section of a pair of plane mirrors is twice the angle between the mirrors, independent of the orientation of these about an axis normal to the principal section. An expression is obtained for the error introduced by a rotation of the mirror-pair about a skew axis. H. H. HOP.

535.312 = 3 3217

Calculation of the lateral displacement of a totally reflected ray. ARTMANN, K. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 87–102 (1948) *In German.*—The displacement D, perpendicular to the direction of propagation, suffered by a ray when a plane e.m. wave limited by an opening is totally reflected, is calculated on the basis of the classical theory of diffraction. It is found that $D = -\frac{1}{2}\lambda\pi^{-1}d\phi/di$, where λ is the wavelength in the denser medium, ϕ the phase change at total reflection and i the angle of incidence. The result agrees partially with experiment. L. P.

535.313.6 : 535.422 3218

The diffraction structure of the elementary coma image. KINGSLAKE, R. *Proc. Phys. Soc., Lond.*, **61**, 147–58 (*Aug.*, 1948).—The integrations reported in this paper demonstrate conclusively that the elementary coma image is of the size and shape determined by ordinary geometrical optics, and that the only effect of diffraction is to break up the image into an elaborate fine structure of dots and lines of light. Practically all the light in the image is confined within the triangular space between the principal ray at the tip of the figure and the sagittal focus. Between the sagittal and tangential foci there is a small amount of light broken up into a series of approximately concentric curved bands of darkness and light, centred about the brightest part of the image. Even when the amount of coma is very small, comparable to the Rayleigh Limit, the characteristic shape of a typical coma-image is already making its appearance. The accuracy of the theoretical predictions is fully and completely borne out by the actual photographs of a comatic image. A.

535.317 = 3 3219

On a new representation of the third order image errors. I. MARX, H. *Optik*, **2**, 364–81 (*Oct.–Nov.*, 1947) *In German.*—By the introduction of new variables, the Seidel aberration coefficients are obtained in a form in which the constructional variables of the system may be varied independently. This leads to a method by means of which the data of a system free from aberration may be obtained by explicit algebra. Unfortunately the systems so found are not practicable ones in most cases. H. H. HOP.

535.317.6 = 3 3220

Spherical aberration of thin single lenses according to D. Argentieri. WATZLAWEK, H. *Öst. Ingen.-Arch.*, **2** (*No.* 2) 114–22 (1948) *In German.*—Argentieri's method of optical correction uses analytic, but no trigonometric, equations. The method is explained and shown to yield identical results with the Clairaut–Schleiermacher and Coddington–Taylor methods, which are, however, more laborious. The shape of the lens having minimum spherical aberration is calculated for various refractive indices. The Argentieri method is applicable also to compound lenses, and is considered the quickest and best method of aberration calculation for industrial optics. V. W. R.

535.317.6 : 535.81 3221

Lens design and tolerance analysis methods and results. FOOTE, P. C., AND WOODSON, R. A. *J. Opt. Soc. Amer.*, **38**, 590–9 (*July*, 1948).—The need for a systematic design and tolerance analysis of optical systems arises from the demand for better optical systems manufactured more economically. Methods are presented for obtaining the optimum design possible with a given type of system using Design Analysis, and for specifying optical and related mechanical tolerances for most economical manufacture using Tolerance Analysis. First-order analysis controls the Gaussian 1st-order optical dimensions; 3rd-order analysis controls the 3rd-order aberrations. A simple extension of the procedure will take care of higher order aberrations. A.

535.322.4 : 541.127 3222

A refractometric method for following reactions in closed systems. MELVILLE, H. W., AND WATSON, W. F. *Trans. Faraday Soc.*, **44**, 68–77 (*Jan.-Feb.*, 1948).—A refractometer was devised for measuring continuous changes in refractive index of transparent liquid systems contained in a cylindrical vessel, without disturbing the contents. The apparatus is suitable for measuring the course of liquid-phase polymerization reactions, particularly in the gel stage. The geometric optics were investigated and conditions are stated for obtaining a wide range of sensitivity of measurement and for designing the instrument to be equally sensitive within the desired range of refractive index. Experimental details of construction and of choice of reaction vessels are given. A.

535.324 : 532.14 3223

Fluctuations in the refractivity of water. HAWKES, J. B., AND ASTHEIMER, R. W. Letter in *Phys. Rev.*, **73**, 520 (*March* 1, 1948).—Interferometer observations showed no fluctuations $> 1{\cdot}5\times10^{-6}$ in water held at constant temperature (0·005°c). This corresponds to a density fluctuation $\not> 5\ \mu g/cm^3$.

535.33 : 534.511.2 3224

A note on the paper "On the possibility of observing beat frequencies between lines in the visible spectrum." GRIFFIN, L. R. Letter in *Phys. Rev.*, **73**, 922 (*April* 15, 1948).—See Abstr. 569 (1948). Provided the analysis is confined to one point in space it is agreed that beats should be detectable. But seeing that the detector must have dimensions $\gg \lambda$ the analysis must be extended into 3 dimensions. Doing this, the conclusion is reached that, because of phase variations, the experiment cannot be successful, the finite width of the slit alone being a prohibitive factor. A. H.

535.33 : 534.511.2 3225

Signal-to-noise ratio in photoelectrically observed beats. GERJUOY, E., FORRESTER, A. T., AND PARKINS, W. E. Letter in *Phys. Rev.*, **73**, 922–3 (*April* 15, 1948).—The authors disagree with Griffin's conclusion [Abstr. 3224 (1948)]. In their opinion the limiting factor is not phase variations over the cathode, but the shot effect. A. H.

535.33 : 539.153 3226

New classifications in Re I and structure of the spectrum. KLINKENBERG, P. F. A. *Physica, 's Grav.*, **14**, 269–84 (*June*, 1948) *In English.*—In addition to the classification of the Re I spectrum given previously [Abstr. 911 (1947)] a number of 453 Re I lines have been newly classified. Accordingly 11 new even, 37 odd levels and also 1 high even level have been detected, among which the *J*-value $^{13}/_2$ appears. The low even levels are dealt with in detail and terms belonging to the configurations $5d^56s^2$, $5d^66s$ and $5d^7$ are identified. The 6*s*-electron is more tightly bound than the 5*d*-electron. Other identifications are given tentatively. Evidence is put forward that $5d^56s8s$ $^8S_{7/2}$ has been rightly recognized by Meggers, though th reality was primarily questioned. The total number Re I lines now classified is 1 624, accounted for t 1 644 transitions between 221 spectral levels. In th region above 2 400 Å the classified lines represent near 65% of all known Re I lines.

535.33–15 : 539.132 322

A "metallic" model for the spectra of conjugate polyenes. BAYLISS, N. S. *J. Chem. Phys.*, **16**, 287–9 (*April*, 1948).

535.33.03 : 545.82 322

A condensed arc source unit for spectrochemical analysis. SINCLAIR, D. A. *J. Opt. Soc. Amer.*, **38**, 547–53 (*Jun* 1948).—A description is given of a source unit of th spark-ignited arc type. The unit has some origin features providing wide versatility without elabora equipment. Some critical requirements for the successf operation of this type of source unit are discusse illustrations of various cycles are given, and a comparis made between the different types of arc-current pulses.

535.33.072 : 621.317.755 322

The cathode-ray spectrograph. FELDT, R., AN BERKLEY, C. *Trans. Amer. Inst. Elect. Engrs*, **66**, 105–1 (1947).—[Abstr. 2734 B (1948)].

535.33.08 : 778.3 *see Abstr.* 3559

535.331 : 537.531 *see Abstr.* 3355

535.333–31 : 537.561 323

The ultraviolet spectra and ionization potentials of th hydrides and deuterides of sulfur, selenium, and telluriur PRICE, W. C. Letter in *J. Chem. Phys.*, **16**, 551–2 (*Ma* 1948).

535.335 : 523.872 *see Abstr.* 3090

535.337 : 537.228.5 = 82 32

The influence of an inhomogeneous field of charge particles on the displacement of terms in gas discharge MILIYANCHUK, V. S. *C.R. Acad. Sci. URSS*, **59** (*No.* 4 671–4 (1948) *In Russian.*—Reference is made to the theo of the Stark effect by Debye [Abstr. 754 (1919)] an Holtsmark [Abstr. 753 (1919), 1458 (1924)] and Holt mark and Trumpy [Abstr. 1645 (1925)] which is unab to explain the results obtained by Bartels [Abstr. 10 (1932)] relating to the displacement of Na terms in an ar The author tries to explain the displacement of terms a the result of the influence of the inhomogeneous electr field. The paper only deals with space inhomogeneit The final result of calculations shows that in an inhomo geneous field the displacement approx. $\propto$ (princip quantum number)^4. F.

535.338 : 535.343 323

Self-absorption of spectrum lines. COWAN, R. D., AN DIEKE, G. H. *Rev. Mod. Phys.*, **20**, 418–55 (*Apri* 1948).—I. Introduction. II. Fundamental consideration III. Self-absorption from a wave-mechanical point view. IV. The general case of self-absorption. V. Un formly excited sources. VI. Source with emitting an absorbing atoms spatially separated. VII. Other no homogeneous sources. VIII. Total line intensitie (Resonance distribution and Doppler distribution IX. The effect of self-absorption on working curves fo spectrochemical analysis. X. Experimental. XI. Som applications to spectroscopic problems. L.

535.338.1 323

Mechanism of the emission spectrum of active nitroge HERMAN, L., AND HERMAN, R. Letter in *Nature, Lond* **161**, 1018–19 (*June* 26, 1948).—The effect of temperatu on the afterglow was studied qualitatively, by comparin the emissions at the surrounding temperature, and whe

liquid air was poured in the Dewar vessel in which the discharge tube was immersed. Modifications in the 1st and 2nd positive systems, the 1st negative system, the Goldstein bands and the Green system were noted. To account for the increase of the Goldstein and selected bands of the 2nd positive system it is necessary to assume atomic recombination.

535.338.1 : 538.615 3234

Ratio of g values of the $^2P^0_{1\frac{1}{2}}$ and the $^2S_{\frac{1}{2}}$ states in ionized calcium. McNALLY, J. R., JR. Letter in *Phys. Rev.*, **73**, 1130 (*May* 1, 1948).—This ratio has been determined from Zeeman data taken at fields of the order of 90 000 gauss. The result is $g_{^2S_{1/2}}/g_{^2P_{3/2}} = 1{\cdot}5013 \pm 0{\cdot}0003$, to be compared with the theoretical (Landé) ratio of 1·5000. This may be considered as additional evidence pointing to a possible discrepancy in the value of the magnetic moment of the spinning electron. L. P.

535.338.1/.3 : 537.531 = 4 *see Abstr.* 3356

535.338.3 : 537.523.4 3235

Excitation of the Balmer series lines in hydrogen spark channels. CRAGGS, J. D., WILLIAMS, G. C., AND HOPWOOD, W. *Phil. Mag.*, **39**, 329–44 (*May*, 1948).—For the experimental technique see Abstr. 3207 (1947). The relative intensity ratios for the first 3 Balmer lines, for short sparks in H_2 at 1 atmos. pressure, were determined. Deductions about the excitation conditions in spark channels are made, and a pure recombination or thermal excitation is unlikely to explain them; electron excitation seems to be the operative mechanism. L. S. G.

535.338.332 3236

Hyperfine structure in the spectrum of Np^{237}. TOMKINS, F. S. Letter in *Phys. Rev.*, **73**, 1214–15 (*May* 15, 1948).—By means of a Fabry–Pérot interferometer, fifty lines have been completely resolved—in each case into six components. Thus $J > I$, and $I = \frac{5}{2}$. L. P.

535.338.332 : 539.152.1 *see Abstr.* 3413

535.338.332 : 539.153 3237

Fine structure of the He II line $\lambda = 4\,686$ Å. KOPFERMANN, H., AND PAUL, W. Letter in *Nature, Lond.*, **162**, 33 (*July* 3, 1948).—Fabry–Pérot interferometer measurements showed that the $3^2S_{\frac{1}{2}}$ level lies $0{\cdot}137 \pm 0{\cdot}015$ cm^{-1} above the value given by the Dirac theory, as predicted by Bethe [Abstr. 3608 (1947)].

535.338.334 : 533.7 : 538.615 : 535.343.4–14 *see Abstr.* 3250

535.338.4 3238

Spectrum of iodine oxide (IO) in flames. COLEMAN, E. H., GAYDON, A. G., AND VAIDYA, W. M. Letter in *Nature, Lond.*, **162**, 108–9 (*July* 17, 1948).—The bands were remeasured; they can be arranged in one system which is an extension of Vaidya's B system [Abstr. 4983 (1937), 1290 (1946)] with modified values of v''. Band heads, molecular constants and dissociation energy are listed.

535.338.4 3239

Hydride and deuteride bands of aluminium, copper, silver and gold. NILSSON, B. E. Letter in *Nature, Lond.*, **162**, 109 (*July* 17, 1948).

535.338.4–15 3240

Infra-red emission spectra of hot liquids. KAPFF, S. F. *J. Chem. Phys.*, **16**, 446–53 (*May*, 1948).—When a liquid is heated as a thin film, specific infra-red emission bands are observed, most of which are of the same wavelength as the absorption bands of the material. These emission bands are rapidly obscured by the background radiation as the thickness of the film is increased. The optimum sample thickness $\simeq 0{\cdot}001$ in with most of the bands being obscured at thicknesses of 0·010 in. The intensity of any band increases with temperature according to the equation $N_1 = N_0\varepsilon^{-E/RT}$. The value of E calculated from this equation agrees in most cases with that calculated from the wavelength of the emission band. Certain bands were observed which are not equivalent in emission and absorption. It is tentatively suggested that these may be explained on the basis of overtone and combination bands. A.

535.338.41 : 517.948 = 82 3241

An approximative method of calculating the diffusion of resonance radiation. BIBERMAN, L. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 659–63 (1948) *In Russian.*—The integral equation obtained in the usual treatment presents some difficulties, thus an approximative method of estimating the part played by the diffusion of radiation is attempted. Assuming that Δn_2 (number of photons absorbed by the gas surrounding the isolated vol. element) $= \Delta N$ (number of photons absorbed within the vol. element), Δn_1 (the number of photons which have escaped from the whole gas vol.) $= A - B$, where A and B are numbers of transitions to, and from, the level under consideration, due to different collisions. If θ is the probability for a photon to escape unabsorbed from the volume element beyond the boundaries of the whole gaseous mass, $n_1 = (n_a/\tau)\theta$, where n_a = concentration of excited atoms on a certain level, and τ the natural period of life of that level. If $\tau/\theta = \tau_{eff}$ then $n_a/\tau_{eff} = A - B$, an equation similar to that for a stationary (non-diffusion) condition, the only difference being that τ_{eff} has been substituted for τ. The value τ_{eff} is the local effective life of the excited state. In the case of a plane layer, the integral equation for θ was solved by the method of successive approximations. For a real discharge in a cylindrical tube, the equation becomes complicated. It can be simplified by considering only such excitations as are due to photons formed within 2 hemispheres whose radii are equal to the distance between the vol. element and the wall of the tube along its diameter. The approx. solution of the simplified equation yields the distribution of excited atoms in the cross-section of the discharge for different optical densities and different conditions of excitation. Similar values are obtained by the τ_{eff} method. F. L.

535.339 = 3 3242

Quantitative work with monochromators. RÖSSLER, F. *Optik*, **2** (*No.* 2) 99–105 (1947) *In German.*—The transmission of spectrographs and single and double monochromators is the product of the transmissions of the slits and the materials. Under "transmission of materials" are grouped reflections, absorptions, polarization and errors in the optics. These transmissions are discussed and their determinations investigated. Among special topics included is the use of slit variation to separate a line from a continuous background, and the determination of the spectral energy distribution of a source. A. C. M.

535.343 : 535.338 *see Abstr.* 3232

535.343–15 = 3 3243

The infra-red absorption power of certain metals at room temperature and at −183°C. WEISS, K. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 1–18 (1948) *In German.*—The Drude formula has been re-examined for Mn, Cu and Fe by a calorimetric technique which is described. The experimental data for Mn agree well with the Drude formula. The greater part of the measured absorption in Cu and Fe appears to arise from an essentially temperature-independent mechanism. W. R. A.

535.343.2–15 = 3 3244

Absorption of rare earth salts in the u.v. SINGH, S. *Optik*, **2** (*No.* 2) 133–48 (1947) *In German.*—Absorption spectra of solid rare earth salts were photographed at room and liquid-air temperatures. The optical symmetry was investigated in $Eu(C_2H_5SO_4)_3 . 9H_2O$; $Eu(BrO_3)_3 . 9H_2O$; $Eu_2(SO_4)_3 . 8H_2O$; and $Gd(BrO_3)_3 . 9H_2O$, using polarized light. The ultraviolet absorption corresponded to induced dipole radiation. From these investigations, with the help of results from other work, term schemes were constructed for Eu^{+++} from 4 680–37 400 cm^{-1}, and for Dy^{+++} from 1 645–33 900 cm^{-1}. The influence of the crystal lattice on the various terms was tested. A. C. M.

535.343.2–15 = 4 3245

Infra-red absorption spectra of metal trimetaphosphates. LECOMTE, J., BOULLÉ, A., AND DOMINÉ-BERGÈS, M. *C.R. Acad. Sci., Paris*, **226**, 575–7 (*Feb.* 16, 1948) *In French.*

535.343.3–15 : 535.375.51 3246

The infra-red and Raman spectra of heavy cyclo-octatetraene. LIPPINCOTT, E. R., LORD, R. C., JR., AND MCDONALD, R. S. Letter in *J. Chem. Phys.*, **16**, 548–9 (*May*, 1948).

535.343.3–15 : 536.753 : 535.375.56 *see Abstr.* 3274

535.343.3–15 : 539.132 3247

Molecular interaction and infra-red absorption spectra. DAVIES, M. *J. Chem. Phys.*, **16**, 267–79 (*April*, 1948).—**I. Methyl alcohol** (267–74). A study was made of the absorption spectra between 3 μ and 15 μ of CH_3OH at varying concentrations in solution. Clear indications were obtained of at least two new bands outside the 3 μ region which arise from the associated molecules. The data allow of a further discussion of the vibrational assignments in methyl alcohol and some of the uncertainties in that respect have been removed. **II. Phenol** (274–9). The spectra of phenol in solution, between 6·5 μ and 15 μ, were studied with particular attention to the qualitative changes on varying the concentration and temperature. Prominent features appearing only in the more concentrated solutions are ascribed to vibrations in associated molecules. The results are compared with those for CH_3OH, and their general significance is discussed. A.

535.343.4 3248

A search for spectral absorption in active nitrogen. WORLEY, R. E. *J. Chem. Phys.*, **16**, 533–6 (*May*, 1948).—A 13-metre path, at pressures of a few mm, was used. A supplementary observation of the O_2 "atmospheric" bands indicated that an allowed transition would have been detected at a concentration of 10^{10} molecules/cm^3 in the initial vibrational level. Absence of the 0–0 band of N_2^+ implies that the ion is not a primary carrier of the energy, as was proposed by Mitra. Failure to observe first positive bands (N_2, $B^3\Pi \leftarrow A^3\Sigma$) is discussed. A speculation is advanced concerning the activated molecules. A.

535.343.4–14 3249

Minimum detectable absorption in microwave spectroscopy and an analysis of the Stark modulation method. HERSHBERGER, W. D. *J. Appl. Phys.*, **19**, 411–19 (*April*, 1948).—The minimum detectable absorption coefficient for an isolated spectral line as measured in a matched wave guide of optimum length is calculated. The equivalence between cavity and wave-guide methods is developed. The Stark modulation method [Abstr. 1814 (1947)] is analysed and expressions are developed for the modulation factor of a microwave at twice and four times the frequency of the Stark field. The shift in line position is calculated, and finally, the directions in which improv ment in sensitivity may be expected are indicated.

535.343.4–14 : 535.338.334 : 533.7 : 538.615 32

Saturation effects in the microwave spectrum of ammoni KARPLUS, R. Letter in *Phys. Rev.*, **73**, 1120 (*May* 1948).—Explains that the Zeeman components of ea line saturate separately. Consequently the experiment data from Bleaney and Penrose [Abstr. 923 (1948)] indicate that the collision frequency for the interrupti of radiation and that for the restoration of therm equilibrium are identical. D. H.

535.343.4–15 : 551.521.3 32

Erratum: Absorption spectrum of carbon dioxide fro 14 to 16 microns. KAPLAN, L. D. Letter in *J. Che Phys.*, **16**, 426 (*April*, 1948).—See Abstr. 584 (1948).

535.343.4–31 32

The ultraviolet absorption spectrum of benzonitr vapor. HIRT, R. C., AND HOWE, J. P. *J. Chem. Phy* **16**, 480–5 (*May*, 1948).—The spectrum was investigate and many of the observed bands were accounted for terms of ground and excited state frequencies. The da obtained were compared with the data available fro infra-red absorption spectra, the Raman effect, and ea work on ultraviolet absorption spectra. The spectru was shown to resemble closely the spectra of other mon substituted benzenes, particularly in the spacing of t excited state bands from the zero-zero band.

535.345 : 532.694 *see Abstr.* 3146

535.345.6 : 535.41 *see Abstr.* 3278

535.35 : 537.56 = 82 32

The influence of cascade transitions on the form of t excitation function of the mercury lines. KAGAN, Y. N AND ZAKHAROVA, V. M. *J. Exp. Theor. Phys.*, **18**, 52 (*Jan.*, 1948) *In Russian.*

535.37 = 82 32

Reduced law of extinction of the phosphorescence crystals. ADIROVICH, E. T. *J. Exp. Theor. Phys.*, 1 58–73 (*Jan.*, 1948) *In Russian.*—It is shown that t elementary law of extinction when represented in mensionless units depends only on a single paramet the fundamental parameter of phosphorescence, γ. T remaining parameters of the phosphor influence or the values of the characteristic units of time, intensi and integral effect. The extinction law is investigated the condition of saturation phosphorescence, and t dependence of the latter on the degree of the excitation found. The extinction of the phosphorescence is al considered phenomenologically. The theoretical resu are compared with the experimental data.

535.37 : 532.74 32

The quenching of fluorescence in liquids by compl formation. Determination of the mean life of the comple WEBER, G. *Trans. Faraday Soc.*, **44**, 185–9 (*April*, 194 —A simple relation has been derived giving the mean l of the non-fluorescent complex as a function of t mean life of the excited state and the relative efficiency the quenched solution. Experimental evidence is offer to show that the mean life of the complex calculated this way is a constant for a given dye, quencher a solvent, at a fixed temperature. With the techniq employed, accurate determination is only possible f complexes having mean lives within one order of magn tude of the mean life of the excited state of the unquench fluorescence. In other cases a maximum or a minimu value can be given. The complexes studied had me lives ranging from 10^{-9} to 10^{-6} sec. When the no fluorescent form is the anionic or cationic form equilibrium with the fluorescent one, it is possible

determine its mean life in the same way. This has been done for the anionic and cationic forms of riboflavine in equilibrium with the dipolar ion. A.

535.37 : 535.66 = 3 3256

Luminous materials of changing colour. BRAUER, P. *Optik*, **2**, 399–414 (*Oct.–Nov.*, 1947) *In German.*—Describes a study of the effect of such variables as temperature and intensity of irradiation on the colour of certain luminescent materials, and of the effect of changes in the chemical composition, especially the amount of activator present. The response of such materials to a flickering irradiation is studied, and a theory of the change of colour produced by change of frequency is given. J. W. T. W.

535.371 3257

Fluorescence and phosphorescence of diamond at different temperatures. CHANDRASEKHARAN, V. *Proc. Indian Acad. Sci. A*, **27**, 316–20 (*April*, 1948).—The electronic line at 4 156 Å in the fluorescence spectrum of diamond broadens and diminishes in peak intensity as the temperature of diamond is raised from − 180° until at 350° it becomes lost in the background. The integrated intensity remains sensibly constant from − 180° to 150°. Phosphorescence at low temperature is weak with a greenish-yellow afterglow but, on raising the temperature, the glow becomes intense and blue. This blue glow can be quenched by red or green light. W. R. A.

535.371 3258

The blue luminescence of zinc sulfide. KROEGER, F. A., AND HELLINGMAN, J. E. *J. Electrochem. Soc.*, **93**, 156–71 (*May*, 1948).—It is shown that the ions Cl^-, Br^-, and I^- play an essential part in the blue centres of ZnS·Ag, ZnS·Zn, and ZnS·Cu phosphors. The centres are assumed to be Ag^+Cl^-, and Cu^+Cl^-, respectively (or the corresponding bromides and iodides), and to occupy normal Zn and S sites in the zinc sulphide lattice. The spectral distribution of the fluorescence is the same for the centres containing Cl or Br ions; Ag, Zn, and Cu cause bands at slightly different wavelengths. A difference in peak positions for wurtzite and sphalerite is explained by the difference in separation between the upper occupied and the lower empty energy band of the base lattice. A.

535.371 = 4 3259

The duration of emission of fluorescent solutions. BRUNINGHAUS, L. *Ann. Phys., Paris* (*Sér.* 12) **3**, 199–276 (*March–April*, 1948) *In French.*—After an introductory discussion on energy levels and the form of emission curves for fluorescent solutions, a historical account of methods which have been used for finding the mean life of excited states is given. A detailed account of a modification of the instrument used by Gaviola follows, in which the difficulties which arise from using the Kerr effect in nitrobenzene are avoided by substituting two quartz pieces, one of which is subjected to a high frequency field. Two successive arrangements are described, in the second of which difficulties due to diffused and reflected light are reduced. Observations on quinine sulphate are given, and a mean life of $6 \pm 2 \times 10^{-8}$ sec is deduced. With fluorescein $1{\cdot}7 \times 10^{-8}$ sec. is obtained. C. C.

535.371 = 82 3260

Special properties of new infrared sensitive alkaline earth phosphors. ANTONOV-ROMANOVSKIĬ, V. V. *C.R. Acad. Sci. URSS*, **58** (*No.* 5) 771–4 (1947) *In Russian.*—Reference is made to a previous paper (*C.R. Acad. Sci. URSS*, **9** (*Nos* 4–5) 369 (1945)] suggesting that ultraviolet light not only excites the phosphor but sometimes accelerates the emission of light, i.e. acts similarly to infrared light. If the optical excitant accelerates the emission, then the light sum attains the limiting value for stored light sum even at relatively weak light intensities. This limiting value can be due to various reasons, four of which are analysed in the paper. F. L.

535.371 = 82 3261

On the nature of the different types of luminosity of phosphors with deep levels of localization. LARSHIN, V. L. *J. Exp. Theor. Phys.*, **18**, 82–95 (*Jan.*, 1948) *In Russian.*—The separate existence of deep flash levels and lower levels of phosphorescence has been established for CaS·SrS–Ce, Sm, and La phosphors. Furthermore, the uniform distribution on the two systems of levels, i.e. the equality of the probability of the localization of the electrons of the conductivity band on either of the levels was ascertained. The nature of the basic luminescence at excitation as well as of that at the recombination of electrons either not susceptible of a preliminary localization or being localized on exceedingly low levels was established. Eventually the dependence of the probability of the processes of recombination and localization on increased exposition and the degree of fullness of the levels of localization was investigated. A.

535.371 : 532.77 = 3 3262

Intermolecular energy transference and fluorescence. FÖRSTER, T. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 55–75 (1948) *In German.*—A quantum-mechanical treatment of the passage of electron excitation energy between neighbouring molecules in solution is given. The critical molecular separation, below which energy transference occurs during the time of excitation, is obtainable from the absorption and emission spectral data and the mean life of the excited molecules. Figures of 50 Å and 80 Å are deduced for fluorescein and chlorophyll, corresponding to solution concentrations of $3{\cdot}2 \times 10^{-3}$ and $7{\cdot}7 \times 10^{-4}$ mol./litre respectively. Equations are given for the energy transference from the originally excited molecules in the regions both above and below the critical concentration. Good agreement with polarization/concentration measurements is found. The bearing of these results on energy dissipation in crystals and energy assimilation in plants is discussed. C. C.

535.371–15 3263

Infrared-sensitive phosphors of the alkaline earth sulfides and selenides. WARD, R. *J. Electrochem. Soc.*, **93**, 171–6 (*May*, 1948).—A review of previously published work supplemented by a description of a new technique to determine activator distribution. This technique employs radioactive tracers in probing the structure of luminescent materials. Experimental data resulting from the use of the new technique are given. A.

535.372 3264

The fluorescence of acetone vapor. LUCKEY, G. W., DUNCAN, A. B. F., AND NOYES, W. A., JR. *J. Chem. Phys.*, **16**, 407–10 (*April*, 1948).—The "blue" fluorescence was photographed with a large Littrow-type spectrograph giving a dispersion of about 16 Å/mm in the range used. Numerous bands having a roughly uniform spacing of $\sim 122 \pm 10$–15 cm^{-1} were observed and their frequencies determined. Certain suggestions are made concerning the vibration analysis. The existence of structure in this fluorescence shows that it is unnecessary to assume that dissociation of the molecule accompanies the emission of fluorescent radiation. On the other hand, the existence of structure cannot be taken to prove the absence of dissociation following the emission process. A.

535.372 3265

Emission spectra of zinc–cadmium sulfides. STUDER,

F. J., AND LARSON, D. A. *J. Opt. Soc. Amer.*, **38**, 480–1 (*May*, 1948).—Re-examination of the phosphor samples used by Byler [Abstr. 931 (1948)] has failed to establish his claim that the emission bands are complex. S. T. H.

535.372 3266

Emission spectra of silicate phosphors with manganese activation. BUTLER, K. H. *J. Electrochem. Soc.*, **93**, 143–56 (*May*, 1948).—The emission spectra of Mn-activated Zn orthosilicate, Zn Be silicate and Ca silicate can be expressed as the sum of several Gaussian distribution curves. The observed distributions for Zn orthosilicate and for Ca silicate can be fully given as the sum of three bands, while that of Zn Be silicate requires five bands. In general, only the amplitude of the bands is affected by changes in composition with their location and sharpness remaining unchanged. Based on the hypothesis that transitions between energy levels of Mn ions in the crystal lattice are responsible for the emission of visible light, tentative assignments are given for the transitions responsible for each observed band. The geometry of the crystal lattice is shown to influence the location of the bands as exemplified by the difference between Zn silicate and Ca silicate. Modifying ions, such as Be, are shown not to affect the band locations though they cause the development of new bands not previously observed in the unmodified phosphor. A hypothesis for this appearance of new bands is proposed in terms of a change in electron spin. A.

535.372 : 539.157 = 82 3267

Metastable atoms in a fluorescent lamp. PANEVKIN, K. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 683–6 (1948) *In Russian.*—F. Butaeva and V. Fabrikant have indicated that high output values of the resonance line 2 537 Å [Thayer and Barnes, *J. Opt. Soc. Amer.*, **29**, 131 (1939)] cannot be explained without taking into consideration collisions between metastable Hg atoms 6^3P_2 or 6^3P_0 and electrons or A atoms. The life period of these metastable atoms is $\ll$ the diffusion value. The life period of excited Hg atoms in the fluorescent lamp positive discharge column has been experimentally determined at $I = 350$ mA, $p(\text{Hg}) = 0{\cdot}01$ mm Hg, $p(\text{A}) = 4$ mm Hg, discharge-tube dia. 36 mm. The method consisted in determining the decrease of absorption of the visible triplet ($6^3P_{0,1,2} - 7^3S_1$) after switching off. The curves of absorption decrease were transformed into curves of concentration decrease of Hg atoms. When compared with the diffusion value, the life period values of excited atoms indicate that in the positive discharge column the destruction of metastable atoms occurs only within the volume of the gas, so that diffusion towards the wall can be neglected. Calculation of acts of elementary excitation of levels 6^3P_2 and 6^1P_1 of Hg (resonance lines 2 537 and 1 850 Å) was carried out. Only transitions for which cross-section values are known were taken into consideration. Experimental values of the life period lie between values calculated on the assumption that the destruction is due only to collisions of the 2nd kind (with electrons), and those based on collisions of the 2nd kind with A atoms. In the absence of quenching, the intensity of radiation is determined only by the number of collisions of the 1st kind between normal Hg atoms and electrons, and collisions raising metastable atoms to the radiation level. The intensity of radiation of a spectral line per cm of discharge column is $I_{2537} = 0{\cdot}09$ W (direct excitation) $+ 0{\cdot}12$ W (transition from metastable state) $= 0{\cdot}21$ W, $I_{1850} = 0{\cdot}09$ W (direct excitation), the electrical input per cm of discharge column length being $0{\cdot}36$ W. Without addition of A the respective values are: $I_{2537} = 0{\cdot}05$ W; $I_{1850} = 0{\cdot}10$ W. F. L.

535.372 : 548.73 3268

The structure of calcium silicate phosphors. FONDA, G. R., AND FROELICH, H. C. *J. Electrochem. Soc.*, **93**, 114–22 (*April*, 1948).—X-ray diffraction patterns were obtained for a variety of synthetic $CaSiO_3$ phosphors containing increasing amounts of PbO, MnO or both and fired in different atmospheres and at different temperatures. Powders with and without PbO alone were found to give α or pseudowollastonite structure even when prepared as low as 1 150°C; powders containing MnO, or PbO and MnO as activators showed increasing prominence of the low temperature β structure with increasing content of MnO, even when fired considerably above the "normal" inversion temperature of 1 200°C. The effect of steam in the preparation of the phosphors appears to be mostly catalytic with respect to rate of reaction and the development of more perfect crystals. The difference in fluorescent sensitivity between Mn-activated phosphors with and without additional PbO cannot be explained on the basis of their (identical) lattice structure. The difference in light emission, however, might be correlated with the α and β structures respectively. A

535.372 : 621.327.43 3269

Manganese activated calcium silicate phosphors. FROELICH, H. C. *J. Electrochem. Soc.*, **93**, 101–13 (*April* 1948).—Single activated $CaSiO_3 \cdot$Mn phosphors absorb very little λ2537 radiation and, consequently, do not fluoresce appreciably when so excited. Under cathode ray excitation the emission is strong and is made up of two bands, one peaking at 5 600 Å, the other at 6 200 Å, the longer of the two becoming more prominent at higher concentrations of MnO. Complete solid solution of larger amounts of MnO is made possible by firing the phosphors in atmospheres of steam and of H_2. Single activated $CaSiO_3 \cdot$Pb phosphors produce blue or ultraviolet fluorescence, depending upon the conditions of preparation. Double activated $CaSiO_3 \cdot$Pb$\cdot$Mn phosphors, preferably prepared by steam firing, provide acceptable substitutes for Zn Be silicate phosphors. They emit both visible light and useful ultraviolet when excited by λ2537. Their sensitivity, efficiency, and colour make them useful for application in fluorescent lamps. They show exceptionally bright second stage phosphorescence, and remarkable temperature stability. To explain the mechanism of light production in double-activated phosphors, internal optical excitation and paired Pb–Mn centres are ruled out, and a mechanism first proposed by Rothschild is tentatively accepted. A

535.375.5 3270

The Raman spectra of water, heavy water and ice. NARAYANASWAMY, P. K. *Proc. Indian Acad. Sci. A*, **27**, 311–15 (*April*, 1948).—Raman spectra of H_2O, D_2O, and ice are recorded using Hg 2 537 as exciting radiation. New bands are reported for D_2O at 60 cm^{-1} and for ice at 213–310 cm^{-1}. W. R. A.

535.375.5 3271

Raman spectrum of ammonium bromide and its variation with temperature. KRISHNAN, R. S. *Proc. Indian Acad. Sci. A*, **27**, 321–35 (*April*, 1948).—Using 2 537Å Hg as exciter, Raman spectra of NH_4Br at 398°, 380°, 173° and 85°K were measured. Lattice lines, the location, intensity and width of which vary with temperature, were reported. NH_4^+ ions do not possess full tetrahedral symmetry although they appear to be more symmetrical in NH_4Br than in NH_4Cl. W. R. A.

535.375.5 3272

The Raman spectra of *cyclo*hexane, glycol and glycerine. NARAYANASWAMY, P. K. *Proc. Indian Acad. Sci. A*, **27**,

336–41 (*April*, 1948).—2 537 Å Hg resonance radiation was used as exciting radiation. Low frequency wings and some new lines are reported. W. R. A.

535.375.51 = 82 3273

Electron spectra and intensities in combination spectra. WOLKENSTEIN, M. V. *J. Exp. Theor. Phys.*, **18**, 74–81 (*Jan.*, 1948) *In Russian.*—The connection between intensity and polarization of the lines of combination spectra and the properties of the normal and excited states of the electrons of the molecules was established by an analysis of the Kramers–Heisenberg and Placzelly formulae. The fact of the polarity of the bond as revealed in the combination spectra coincides with Franck's criterion. Furthermore, the abnormally high intensities in combination spectra of compounds containing "non-additive" bonds are explained. A.

535.375.51 : 535.343.3–15 *see Abstr.* 3246

535.375.56 : 535.343.3–15 : 536.753 3274

Vibrational spectrum and thermodynamic properties of uranium hexafluoride gas. BIGELEISEN, J., MAYER, M. G., STEVENSON, P. C., AND TURKEVICH, J. *J. Chem. Phys.*, **16**, 442–5 (*May*, 1948).—The Raman spectra of liquid UF_6 and of UF_6 dissolved in C_7F_{16} were photographed. Three Raman lines were found for UF_6 at 200, 511, and 656 cm^{-1}. The infra-red spectrum of the gas was obtained in the region between 2 and 17 μ. A vibrational assignment of all the fundamental frequencies was made on the basis of the regular octahedral model. The calculated infra-red active overtones are in good agreement with experiment. Using 2·0 Å as the U–F distance from electron diffraction measurements, the entropy, heat capacity and $-(F^\circ - E_0^\circ/T)$ are calculated from 100°K to 1 000 °K for the gas. The calculated and experimental entropies are in good agreement. A.

535.376 : 548.7 3275

The new phenomena of electrophotoluminescence and its possibilities for the investigation of crystal lattice. III–IV. DESTRIAU, G. *Phil. Mag.*, **38**, 880–8 (*Dec.*, 1947).—See Abstr. 1517, 2795 (1948). The extinction of visible phosphorescence in sulphides by electric fields is discussed; a quantitative study was made in the case of ZnS–CdS. The acceleration of infra-red extinction of phosphorescence by an electric field was also studied. A.C. fields were used to avoid polarization effects. L. S. G.

535.39 : 535.23.08 3276

The preparation and optical properties of gold blacks. HARRIS, L., MCGINNIES, R. T., AND SIEGEL, B. M. *J. Opt. Soc. Amer.*, **38**, 582–9 (*July*, 1948).—The optical properties of gold smokes deposited on cellulose nitrate films under different experimental conditions have been studied. The conditions of pressure of the inert atmosphere, purity of the gas, rate of evaporation, and the distance between source and deposition surface giving the highest infra-red absorption per unit mass have been found. The thermal mass required for high infra-red absorption is small compared to the thermal masses of other receivers used for infra-red measurements. The gold "blacks" turn yellow and have lower infra-red absorption when heated above 110°c. Gold "blacks" with very high infra-red transmission (3–15 μ) and low transmission at shorter wavelengths are prepared when oxygen is present in the "inert" atmosphere. The particle size and particle distribution of the gold smokes deposited under different experimental conditions have been investigated with the electron microscope at high resolution. A.

535.41 3277

A modification of Benoît's method of exact fractions. MICHAELIS, E. G. *Proc. Phys. Soc., Lond.*, **61**, 194–7 (*Aug.*, 1948).—A process is outlined by which the computations arising in interferometric measurements can be shortened and simplified. A graphical illustration of the method is given, and it is compared with other modifications. A.

535.41 : 535.345.6 3278

Reflection and transmission interference filters. II. Experimental, comparison with theory, results. HADLEY, L. N., AND DENNISON, D. M. *J. Opt. Soc. Amer.*, **38**, 483–96 (*June*, 1948).—Reflection and transmission filters have been constructed by the evaporation process, and their properties have been measured and shown to conform with the theory developed in I [Abstr. 2519 (1947)]. A more extended set of curves of the reflection and transmission coefficients and the phase shift angles of a single metal film are given. From these curves, and from measurements made on the transmission filter, the optical constants of Ag films are deduced and shown to agree with other published data. A typical spectrogram of an infra-red reflection filter is also given, showing a minimum reflection coefficient of $< 1\%$ at the odd overtones of the fundamental frequency. A.

535.417 3279

An improved Jamin interferometer. HAWKES, J. B., AND ASTHEIMER, R. W. *J. Opt. Soc. Amer.*, **38**, 617–22 (*July*, 1948).—For the purpose of studying anomalies in the index/temperature relation of transparent liquids, a Jamin interferometer has been developed using special control equipment for accurate constant-rate temperature variation. Simultaneous recording of optical and thermal changes are made on a constant-speed paper tape. Estimated precision, $0{\cdot}7\times10^{-6}$ index units/deg. c; actual reproducibility, 1 to 2×10^{-6}. A.

535.417 : 534.133 *see Abstr.* 3171

535.42 : 534.321.9 : 534.614 3280

Diffraction of light by very high frequency ultrasonic waves. BHAGAVANTAM, S., AND RAMACHANDRA RAO, B. Letter in *Nature, Lond.*, **161**, 927 (*June* 12, 1948).—Earlier work [Abstr. 1195 (1947)] has been extended to 180 Mc/s with similar results; the light rays need to be inclined at 1° 29′ to the sound wave for the 1st-order lines to appear at 177·2 Mc/s. The velocity of sound in water at this frequency was the same as at 15 Mc/s.

535.422 : 535.313.6 *see Abstr.* 3218

535.424 : 535.822 = 3 3281

A simple account of the phase-contrast microscope. RICHTER, R. *Optik*, **2**, 342–5 (*Oct.–Nov.*, 1947) *In German.*—The disturbance transmitted by a phase-object is considered as that due to a perfectly uniform object plus a subsidiary diffracted wave associated with a small area of different phase-thickness. It is concluded that only a series of phase-plates in finite steps is required to cover any range of phase-variation in the object, which is assumed to be of uniform transmission. H. H. HOP.

535.424 : 535.822 : 621.386.833 = 3 3282

On Fresnel diffraction in the light and electron microscope. KINDER, E., AND RECKNAGEL, A. *Optik*, **2**, 346–63 (*Oct.–Nov.*, 1947) *In German.*—A light analogue of the electron microscope of relative aperture 10^{-3} has been used to study Fresnel diffraction effects associated with images of isolated spots and simple and multiple black-white boundaries. In the electron microscope, as opposed to the light microscope, the in- and out-of-focus images of the edge of an opaque screen show sharp and diffuse fringes. This can be explained on the assumption that a more intense diffracted wave penetrates the region of the shadow in the case of illumination of low angular

aperture. Photomicrographs are given illustrating a number of cases. H. H. HOP.

535.43 : 541.182.6 *see Abstr.* 3490

535.43 : 551.593 *see Abstr.* 3041

535.434 : 541.64 3283

The dependence of the scattering of light on angle and concentration in linear polymer solutions. ZIMM, B. H. *J. Phys. Coll. Chem.*, **52**, 260–7 (*Jan.*, 1948).—Some additions to the theory of optical scattering from solutions of linear polymers, i.e. for molecules of thread-like or rod-like shapes, forming an extension of the author's previous work [*J. Chem. Phys.*, **14**, 164 (1946)] on dependence of scatter on distribution of the molecules. Though no finality is claimed for either theory or experimental data, their agreement seems to be quite satisfactory.

535.514.2–15 3284

An efficient, convenient polarizer for infra-red radiation. NEWMAN, R., AND HALFORD, R. S. Letter in *Rev. Sci. Instrum.*, **19**, 270–1 (*April*, 1948).—A transmitting polarizer formed by an inclined pile of thin sheets ($2{\cdot}5\times2{\cdot}5\times0{\cdot}002$ in) of optical AgCl is described. It is claimed that for an angle of incidence of $\sim 70°$ and a pile of ~ 12 sheets, used with parallel radiation, 50% of the incident radiation would be transmitted practically completely polarized. This efficiency should prevail throughout the range 5 to 20 microns. Details of tests made on the polarizer, which is rugged, compact and readily made, are given. [See Abstr. 1845, 2858 (1947), 1295 (1946)].

H. G. J.

535.55 = 3 3285

A new method of evaluation in stress-optical analysis. VASARHELYI, D. *Öst. Ingen.-Arch.*, **2** (*No.* 1) 64–76 (1947) *In German.*—A photo is taken of the curves of equal principal stress, and the curves of equal stress difference are photographed or determined point-by-point. From the above photos the principal stress diagram is obtained. The stress lines are then measured graphically and the results analysed and tabulated. The principal stresses can then be calculated for any given cross-section of the model. The method is quicker and more exact than previous methods. The process is exemplified on a perforated celluloid plate under eccentric loading. V. W. R.

535.55 : 537.212 3286

Analogy between isopachic stress lines and equipotential lines. MUELLER, R. E. Letter in *J. Appl. Phys.*, **19**, 590 (*June*, 1948).—Referring to a paper of Frocht [Abstr. 2324 (1939)] the writer points out the possibility of obtaining equipotential lines photographically.

535.62 : 621.397.3 3287

Application of projective geometry to the theory of color mixture. BINGLEY, F. J. *Proc. Inst. Radio Engrs, N.Y.*, **36**, 709–23 (*June*, 1948).—Describes a simple and rapid graphical method for determining that point on the colour diagram which represents a mixture in specified proportions of lights represented by two given points. This method is used for studying the performance of equiluminous primary systems in colour television. The maximum luminosity demand for any primary may be considerably in excess of the demand when reproducing white and this must be allowed for if colour distortion is to be avoided. J. W. T. W.

535.62 : 778.643 *see Abstr.* 3564

535.66 : 535.37 = 3 *see Abstr.* 3252

535.661.3 : 666.24 3288

Color variations in glasses containing iron. FORREST, J. W., KREIDL, N. J., AND PETT, T. G. *J. Opt. Soc. Amer.*, **38**, 554–60 (*June*, 1948).—The variations of the colour of Fe glasses are due to the fluctuations in (*a*) concentration, and (*b*) oxidation-reduction equilibrium. In an experimental series, changes of these two variables were exaggerated. An increase in concentration caused a decrease in transmission and a shift to higher dominant wavelengths (yellow), while reduction caused a decrease in transmission and a shift to lower dominant w.l.'s (blue). The changes in chromaticity were evaluated and applied to problems of control and specification. The Nickerson-Balinkin small colour difference formula indicated a modification of existing specifications in transmission and dominant w.l. with tolerances equal in three colour dimensions. A

535.735 : 535.88 : 778.55 = 3 *see Abstr.* 3561

535.736.14 : 535.242.62 328

The luminosity curve of the eye as determined by measurements with the flickerphotometer. DE VRIES, H. *Physica, 's Grav.*, **14**, 319–48 (*June*, 1948) *In English.*

I. Experimental part (319–33).—The influence of test field brightness on the results of flicker-photometry has been studied. In the greater part of the measurements, a red and a green test field have been compared. Further the influence of a coloured background, on which the test field was superimposed, has been examined. Various normal trichromats, anomalous trichromats and dichromats were observers. It is found that, below 50 photons simple laws are valid for the photometry. The adjustment of the photometer does not then change if the brightnesses of all components are multiplied by the same factor, or if a background is added. At higher brightness levels deviations occur.

II. Implications for the theory of colour vision (334–40).—A tentative explanation of the influence of the brightness level on the shape of the luminosity curve is given. The explanation also covers the case of anomalous trichromats and of dichromats, as well as the phenomena observed in the presence of a coloured background. Apart from this explanation the measurements given in I are in support of the trichromatic theory.

III. The influence of previous adaptation to coloured bright fields (341–8). The influence of previous adaptation to bright coloured fields (e.g. 10^5 photons) on the adjustment of the flicker photometer, has been studied. In the greater part of the measurements red and green lights were compared in the test field. Several normal trichromats, one deuteranomalous, a protanope and a deuteranope were observers. The final conclusion is that the bright fields induce a deformation of the sensitivity curves of the receptors. Evidence is given that the original molecules of the photochemical substance are "bleached away" by the adapting light. The rate of bleaching calculated is compatible with the results obtained. A

535.8 329

Athermalization of optical systems. GREY, D. S. *J. Opt. Soc. Amer.*, **38**, 542–6 (*June*, 1948).—Equations are given for the condition that the focal surface of a lens system remain at a predetermined position for a range of ambient temperatures. Simple methods of satisfying these equations for lens systems composed predominantly or entirely of plastic components are described. A

535.81 : 535.317.6 *see Abstr.* 3221

535.822 : 535.424 = 3 *see Abstr.* 3281

535.822 : 621.386.833 : 535.424 = 3 *see Abstr.* 3282

535.83 = 4 329

Visual optical instruments of very large field. ARNULF, A. *Rev. Opt. (Théor. Instrum.)* **27**, 174–7 (*March*, 1948) *I*

French.—By the use of a concave field mirror, in place of a lens, both Petzval curvature and astigmatism in telescopes may be corrected. A number of examples is given. H. H. HOP.

535.88 : 513.76 = 3 3292

On affine image-transformation by optical projection. SCHWIDEFSKY, K. *Optik*, **2**, 434–44 (*Oct.–Nov.*, 1947) *In German.*—General projective relationships are formulated, and an account given of the setting up of two common types of projectors to produce a desired image from a given original by means of two successive projections. H. H. HOP.

535.88 : 535.735 : 778.55 = 3 *see Abstr.* 3561

535.89 : 535.245.24 : 621.325.17 3293

The normal probability curve as an approximation to the distribution curve of the high intensity searchlight. BENFORD, F., AND BOCK, J. E. *J. Opt. Soc. Amer.*, **38**, 527–31 (*June*, 1948).—The light from high-intensity electrodes comes principally from the luminous gas confined within the hemispherical crater of the anode. The distribution of intensity in the beam formed by the source with an accurate paraboloidal reflector has a marked resemblance to the normal probability curve. This resemblance has been investigated, and the agreement between curve and test is remarkable. From both theory and test, it is known that the beam formation is influenced by the ratio of the focal length of a mirror to its diameter, and the standard form of mirror has been found to give the best agreement with the probability curve. Three sizes of searchlight, 24 in, 36 in and 60 in. in diameter, have been investigated and all give the same distribution. From these facts, it seems that the probability curve is applicable throughout the range of standard high intensity practice. Several attempts at a theoretical derivation have failed, and the data are presented solely as a complete collection of available field tests. A.

535.89 : 535.245.24 : 621.325.17 = 82 3294

Analytic representation of the curve of luminous intensity of a projector. RUMYANTSEV, M. V. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 691–2 (1948) *In Russian.*—It is shown from experimental data that in many cases the actual distribution of the luminous intensity of a projector can be represented fairly well by the Gaussian probability curve. The formulae derived for the luminous flux are in agreement with experimental results. F. B.

HEAT 536

536.081.3 : 536.74 *see Abstr.* 3322

536.21 : 621.316.3.066.6 3295

Calculation of the temperature development in a contact heated in the contact surface, and application to the problem of the temperature rise in a sliding contact. HOLM, R. *J. Appl. Phys.*, **19**, 361–6 (*April*, 1948).—The temperature is calculated in 2 cases: I. A circular area on a semi-infinite body heated at a constant rate from the time $t = 0$. II. A sliding contact, the heat, which is generated by friction, being limited at every point to the time of contact. Observations on the temperatures in bimetallic sliding contacts, indicating the contact temperature rise by means of a thermoelectric current, are compared with the calculations. A fairly good agreement is found. A.

536.212.3 3296

The thermal conductivity of some insulating materials at low temperatures. CHOW, C. S. *Proc. Phys. Soc., Lond.*, **61**, 206–16 (*Sept.*, 1948).—The method of Lamb and Wilson modified for use at low temperatures was used for thermal conductivity measurements of insulating materials in the range of temperature +18 to −180°c. For finely granulated and loosely packed fibrous materials, the temperature gradient was experimentally determined and the intermediate values of the conductivity along the temperature gradient were obtained. For coarsely granulated or loosely packed materials, only the mean conductivity is observed. The general shape of the conductivity-temperature curve in relation to the density of packing for various materials is discussed. For compressible fibrous insulators, the variation of conductivity with packing densities at low temperatures has been found similar to that at normal or moderate high temperatures. Granulated cork, vermiculite, cotton waste, sawdust and slag wool were amongst the materials investigated. A.

536.22 = 82 3297

A formula for the thermal conductivity of liquids. BOROVIK, E. *J. Exp. Theor. Phys.*, **18**, 48–51 (*Jan.*, 1948) *In Russian.*—The formula given describes the character of the variation of the thermal conductivity at the transition from the liquid to the gaseous phase. The agreement with experiment is within 10–20%. A.

536.22 : 536.48 *see Abstr.* 3312

536.23.08 : 536.33 = 3 3298

The performance limits of heat radiation instruments. II. A reply to a criticism of Kappler, E. HETTNER, G. *Z. Phys.*, **124** (*Nos* 3–6) 309–14 (1948) *In German.*—Kappler's criticism and correction of Dahlke and the author's relation [see Abstr. 2086 (1947)] is shown to be based on a difference in definition of "efficiency." Kappler's definition is considered unsuitable, and reasons for this are given. S. W.

536.24 3299

Heat transfer to water boiling under pressure. FARBER, E. A., AND SCORAH, R. L. *Trans. Amer. Soc. Mech. Engrs*, **70**, 369–84 (*May*, 1948).—The film coefficient of heat transfer from a hot metal surface to a boiling liquid was estimated from experiments with an electrically heated wire submerged in the liquid. The heat-flow rate was given by the consumption of electric power. The temp. drop through the film was taken as the difference between the surface temp. of the wire and the mean temp. of the liquid. The surface temp. of the wire was estimated by a small thermocouple. The graph of film coefficient, as a function of temp. drop through the film, is called the "boiling" curve. As the drop increased, the film coefficient first rose to a max., then fell to a min., from which it rose steadily as the temp. drop continued to increase. When water was boiled at atmospheric pressure, different heated metals gave different boiling curves. Preliminary data are given for Ni, W, chromel A and chromel C. When water was boiled at different elevated pressures, the same heated metal gave different boiling curves. Throughout these experiments the general form of the boiling curve remains the same. A.

536.24 3300

Radiative and convective heat transfer rates pertaining to heating processes. HUEBLER, J. *Industr. Engng Chem.*, **40**, 1094–8 (*June*, 1948).—The paper seeks to compare, under theoretically ideal conditions, the effect of radiation and convection heating simultaneously applied to a plate. For this purpose an equivalent radiation "heat transfer coefficient" is utilized, and graphical methods of solution are applied. The results reveal the contribution made by convection alone to the total heat transfer attainable under assumed conditions and its ratio to heat transfer by radiation. A.

536.244 3301

Heat transfer to vertical tubes in a mixing vessel.

RUSHTON, J. H., LICHTMANN, R. S., AND MAHONY, L. H. *Industr. Engng Chem.*, **40**, 1082–7 (*June*, 1948).—Data are presented for heat transfer coefficients from vertical tubes acting as baffles in addition to heat exchange surface in a vertical cylindrical tank equipped with standard design flat blade mixing turbines. Data also show proper positioning of impeller for optimum heat transfer rates. The experimental unit consists of a tank 4 ft in diameter, a dynamometer drive for the agitator, and vertical heating and cooling coils. A.

536.244 : 533.6.011.6 *see Abstr.* 3166

536.25 3302

The role of convection in medium temperature processing with special reference to its influence on the design of "infra-red" ovens. CARNE, J. B. *Fuel Sci. Pract.*, **26** (*No.* 4) 90–101 (1947).—The magnitude of the radiant and convective components of heat transfer to cool objects placed in enclosures with air and walls at various temperatures, are assessed from "heating-up" data. Measurements indicate that the coefficients of natural convection for short vertical plates are considerably less than the values hitherto accepted. Coefficients for short vertical flat plates and spheres $\frac{1}{8}$ in to $2\frac{1}{4}$ in dia. are deduced from thermal equilibrium conditions established by natural convective loss and radiation gain. The significance of the variable convective losses due to shape, size and orientation of surfaces in radiant heat processing is discussed. A.

536.27 : 533.6.011.31 : 532.517 = 82 *see Abstr.* 3133

536.3 : 621.45 : 536.46 *see Abstr.* 3307–9

536.33 : 536.23.08 = 3 *see Abstr.* 3298

536.421.4 : 532.782 *see Abstr.* 3154

536.421.4 : 551.574.7 3303

The production of clouds containing supercooled water droplets or ice crystals under laboratory conditions. SCHAEFER, V. J. *Bull. Amer. Met. Soc.*, **29**, 175–82 (*April*, 1948).—The basic laboratory experiment in which a supercooled cloud may be seeded and converted to ice crystals is described in considerable detail. Such information is given as type and preparation of the cold chamber, light sources which are effective for different purposes, methods to follow in forming supercooled clouds, and procedures to follow in seeding them. The transition temperature at which ice crystals form spontaneously is given as $-39 \pm 0{\cdot}1$°C as the result of a recent study. A simple replica technique for preserving the exact structure of the crystals in plastic is described. A.

536.423 3304

The maximum possible rate of evaporation of liquids. PENNER, S. S. *J. Phys. Coll. Chem.*, **52**, 367–73 (*Feb.*, 1948).—An equation is obtained for the maximum possible rate of isothermal vaporization of liquids. It is shown that the resulting relation for the decrease of droplet radius with time gives results of the same order of magnitude as the relation obtained from the kinetic theory of gases. Assumption of the validity of the new treatment for determining the maximum possible rate of evaporation permits an independent determination of the free volume of a liquid. A.

536.423.15 3305

The vapor pressure of uranium hexafluoride. WEINSTOCK, B., AND CRIST, R. H. *J. Chem. Phys.*, **16**, 436–41 (*May*, 1948).—The vapour pressure, P, was measured, from 273° to 358°K, by a null method in an all-metal apparatus with a brass sylphon bellows. The data were fitted to equations of the form $\log P = A/T + B + C \log T$, where T is the temperature. The constants in the equations were adjusted so that the equations would give the same heat of fusion and triple-point temperature as w determined by Brickwedde, Hoge and Scott [Abstr. 33 (1948)]. P at the triple point is $1\,133 \pm 7$ mm. T sublimation point at which $P = 1$ atmos. is $56{\cdot}5$° The heat of vaporization was calculated using t Berthelot equation to obtain the vapour volume. Fro this and the entropies measured by Brickwedde, t absolute entropy of the gas was calculated.

536.423.15 : 536.71 33

A theory of vapor pressures of liquids based on van d Waals' equation of state. WALL, F. T. *J. Chem. Phys* **16**, 508–12 (*May*, 1948).—The theory involves the use an appropriate mathematical expression for the volu of a van der Waals' liquid and does not require recour to any empirical relationships. The vapour pressu equation obtained can be put into a reduced form, whic is of a universal nature. The laws of Guldberg–Guye ar of Trouton are shown to be compatible with the theor with constants of the correct order of magnitude.

536.423.15 : 541.183.26 *see Abstr.* 3497

536.46 : 536.3 : 621.45 33

Effect of radiation on the rate of burning of solid fu rocket propellants. PENNER, S. S. *J. Appl. Phys.*, 1 392–8 (*April*, 1948).—The temperature rise of powd grains in different rocket motors, resulting from t absorption of radiant energy, was computed. The resul show that more radiant energy is absorbed by the powd grains in large service rockets than in small experiment test motors. The increase in powder temperature befo burning, associated with the absorption of radia energy, leads to an increase in the average rate of burnir of the solid fuel charge. The differences in burning ra produced by the absorption of radiant energy amount less than 4% for the rocket motors commonly employe Thus burning rate results obtained in small test moto may be applied to predict the approximate behavio of the same propellant in a large service rocket.

536.46 : 536.3 : 621.45 33

Qualitative experimental verification of the change burning rate of rocket powders with radiation path lengt PENNER, S. S. *J. Appl. Phys.*, **19**, 511–14 (*June*, 1948).— Experimental studies on step-machined powder grai indicate a small increase in the average burning rate c solid fuel rocket propellants with an increase in t radiation path length. This result is in agreement wit theoretical predictions. A

536.46 : 536.3 : 621.45 330

Some considerations of the effect of radiation on t performance of liquid fuel rockets. PENNER, S. S., AN WEINBAUM, S. *J. Opt. Soc. Amer.*, **38**, 599–603 (*July* 1948).—Equations have been developed for estimating th temperature rise, caused by the absorption of radiar energy, of a small volume element of cool gas or of liquid droplet moving along the axis of a cylindrica chamber. The absorbing material was assumed to mov with constant velocity and to be surrounded at all time by hot radiating gases distributed uniformly throughou the cylindrical chamber. A sample calculation has bee carried out for an absorbing volume element of ga moving with a linear velocity of $1{\cdot}15 \times 10^4$ cm/se through a cylindrical chamber (30 cm in length and 14 cm in diameter) filled uniformly with gray-body emitters a 3 000°K and 20 atmos. pressure. The mass emissivity o the radiating gases was chosen to be 40 cm²/g. Th upper limit for the temperature rise of the moving gases caused by the absorption of radiant energy, was found t be about 100°K for the chosen conditions. A

536.48 331

Transfer rates in liquid helium films. ATKINS, K. R

Letter in *Nature, Lond.*, **161**, 925–6 (*June* 12, 1948).—Experiments are described showing that rate of superfluid transfer, though independent of pressure head, may depend on the height of the film above the free surface. The driving force, in fact, may not be a hydrostatic pressure but a temperature difference arising from various thermal effects. High transfer rates, up to 10^{-3} cm³/sec/cm, can be initiated thermally, under conditions of little or no pressure difference.

536.48 = 82 3311

Motion of extraneous particles in He II. LANDAU, L., AND POMERANCHUK, I. *C.R. Acad. Sci., URSS*, **59** (*No.* 4) 669–70 (1948) *In Russian.*—On the basis of Landau's theory of He II [Abstr. 2052 (1947)] it is shown that any extraneous particles present in small concentration in He II (e.g. He^3, He^6 or electrons) cannot take part in superfluid flow. This agrees with the experimental result of Daunt *et al* [Abstr. 3614 (1947)] and it is pointed out that therefore this experimental result is irrelevant to the question of the existence of a λ-point in pure He^3. D. S.

536.48 : 536.22 3312

Relation between fountain pressure and heat current in helium II. MEYER, L., AND BAND, W. Letter in *Nature, Lond.*, **162**, 67–8 (*July* 10, 1948).—Under conditions of no mass flow, the heat current $W \propto$ fountain pressure difference ΔP between the ends of a capillary or slit, even when (slits $> 10^{-3}$ cm) W is not $\propto$ the temperature difference ΔT [Abstr. 2874 (1947)]. It is suggested that this is because the temp. difference across the slit $\Delta T_1 < \Delta T$, which is measured between the bulk liquids; ΔP and W both depend on ΔT_1.

536.48 : 536.63 : 536.75 3313

The low temperature heat capacities, enthalpies, and entropies of UF_4 and UF_6. BRICKWEDDE, F. G., HOGE, H. J., AND SCOTT, R. B. *J. Chem. Phys.*, **16**, 429–36 (*May*, 1948).—The heat capacity of UF_4 was measured from 20° to 350°K and that of UF_6 from 14° to 370°K. Molar heat capacities were tabulated at 5° intervals and extrapolated to 0°K. From them the entropies and enthalpies of the compounds were found by integration and tabulated. The triple point temperature of UF_6 was found to be 337·212°K and the heat of fusion was found to be 19 193 joules/mole. A.

536.48 : 621.396.621 = 82 3314

Detecting properties of superconductors. GALKIN, A. A., AND LAZAREV, B. G. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 667–8 (1948) *In Russian.*—[Abstr. 2575 B (1948)].

536.5.081 = 3 3315

The concept of temperature and temperature units. EBERT, H. *Phys. Bl.*, **3** (*No.* 12) 414–19 (1947) *In German.*—A historic survey of methods of temperature measurement and the concept of temperature is followed by a description of modern methods of temperature measurement. The following problems have still to be settled: The freezing point of water is not as easily reproducible with accuracy as the triple point of air-free water vapour (equilibrium temp. between steam, air-free water and ice). It is proposed to use the triple point as standard temp. of 273·17°K. At 0°C the standard equation of the Pt resistance thermometer for the range −190°C to 0°C does not agree with the equation for the range 0°C to 600°C. The dimensions of temperature have also yet to be settled. The energy per molecule is a possible basis. [See Abstr. 3316 (1948)]. V. W. R.

536.5.081.3 = 3 3316

The physical dimension of temperature. HÄBERLI, F. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 97–108 (*April*, 1948) *In German.*—The molecular weight is introduced as a fundamental unit in heat. In this connection, the concept of "particle" (since dimensionally the molecular-weight is |mass/particle|) is explained. Thus the dimensions of temperature are not |energy|, but |energy/particle|. The dimensional formulae for the more important thermal quantities are derived, and the c.g.s. and Giorgi systems of units are extended to include heat. For the extended Giorgi system a fundamental unit of temperature = 1/8317 deg K is recommended. [See also Abstr. 222 (1948) and Häberli, F., *Schweiz. Arch. angew. Wiss. Tech.*, **13** (*No.* 5) (*May* 1947)]. S. W.

536.51 3317

Design of temperature-measuring elements. CICHELLI, M. T. *Industr. Engng Chem.*, **40**, 1032–9 (*June*, 1948).—Methods are presented for determining the length of temperature-measuring elements that must extend into a gaseous atmosphere to reduce the error of reading, due to conduction of heat along the unit, to less than a certain value. The solution of this problem and a number of sample calculations are given for most standard types of thermometer and thermocouple installations. A.

536.63 : 536.75 : 536.48 *see Abstr.* 3313

536.633 : 539.132 3318

Gas heat capacity and internal rotation in 1,2-dichloroethane and 1,2-dibromoethane. GWINN, W. D., AND PITZER, K. S. *J. Chem. Phys.*, **16**, 303–9 (*April*, 1948).—The heat capacity was measured for the former in the range 356–556°K, and for the latter, 383–473°K. Potential barriers to internal rotation are selected for the two molecules. A.

536.633 : 541.183.56 3319

The heat capacity of nitrogen adsorbed on titanium dioxide between 20°K and 80°K. MORRISON, J. A., AND SZASZ, G. J. *J. Chem. Phys.*, **16**, 280–6 (*April*, 1948).—A low temperature adiabatic calorimeter suitable for thermal measurements on adsorbed gases was developed. Heat capacity values for two amounts of nitrogen adsorbed on TiO_2 (rutile) are presented. A.

536.655 : 536.71 = 3 3320

Calculation of the heat of vaporization from the equation of state. KÄMMERER, C. *Öst. Ingen.-Arch.*, **2** (*No.* 2) 93–105 (1948) *In German.*—The heat of vaporization of a substance can be calculated when the physical state of the substance at a given temp. is known. Using a modified van der Waals' type equation of state, an expression is derived for the heat of vaporization. An application to CO_2 and H_2O shows appreciable discrepancies between actual and calculated values. Van der Waals' equation itself gives even greater errors. Berthelot's equation leads to smaller discrepancies. Equations of state taking dissociation into account are considered and yield values closer to the measured ones than the other formulae. The effect of temperature on the terms representing dissociation is investigated. V. W. R.

THERMODYNAMICS 536.7

536.7 : 532.7 *see Abstr.* 3150

536.71 : 536.423.15 *see Abstr.* 3306

536.71 : 536.655 = 3 *see Abstr.* 3320

536.71 : 536.73 *see Abstr.* 3321

536.71 : 541.126 : 533.75 *see Abstr.* 3167

536.711 : 532.525 : 533.17 *see Abstr.* 3156

536.73 : 536.71 3321

Thermodynamics. I. The seond law from the standpoint of the equation of state. FINCK, J. L. *J. Franklin Inst.*,

245, 301–17 (*April*, 1948).—The concepts "equilibrium" and "reversibility" are examined from the standpoint of the number of independent variables which define a thermodynamic system. The endeavour is made to show that the number of independent variables which are selected is crucial to the basic concepts as well as to the second law of thermodynamics. If this number is less than the minimum required to define the system completely, the equation of state for the internal energy will be incomplete. It is the practice to employ incomplete equations of state, and this results in processes which are considered to be irreversible. The Kelvin–Planck and Clausius principles are shown to be somewhat related to the first law of thermodynamics, and their validity arises from the fact that the equations of state which are used are incomplete. Were they complete, that is, the number of independent variables not less than the minimum required to describe the systems completely, there would be complete conversion of heat into work, as well as work into heat. The difficulties in realizing complete equations are considered. The entropy concept is considered in detail, and it is shown that there are serious limitations in its application. A.

536.74 : 536.081.3 3322

Thermodynamics. II. Work, heat, and temperature concepts, and an examination of the temperature scale. FINCK, J. L. *J. Franklin Inst.*, **245**, 365–78 (*May*, 1948).—In this paper the concepts of work, heat, and temperature are examined from the standpoint of a complete equation [Abstr. 3321 (1948)] for the internal energy of a system. In an incomplete system energy necessarily remains with the system, which results in the inefficiency of a process. This inefficiency is, of course, appreciable for processes taking place at a finite speed, but is not necessarily eliminated by means of a quasistatic process. The Kelvin temperature scale is shown to be based on an incomplete equation for the internal energy and, therefore, offers certain difficulties. A temperature scale based on a complete equation is shown to have advantages over the Kelvin scale, and it is further shown that the temperature of absolute zero as based on a complete equation is lower than that on the Kelvin scale. A suggestion is offered whereby an actual system may be treated as complete and a temperature scale may be based on this. A.

536.75 : 536.63 : 536.48 *see Abstr.* 3313

536.75 : 539.132 3323

Thermodynamic properties of the internal rotator. Double minimum with repulsive forces. HALFORD, J. O. *J. Chem. Phys.*, **16**, 410–19 (*April*, 1948).—The basis for calculating the properties from energy levels derived from the old quantum theory is described, and a method is outlined for calculations with a potential energy function consisting of linked sections of cosine curve with the width of each section $\propto$ the barrier height. A table of values of a general quantum number index for the cosine function is presented and its application to the unsymmetrical internal rotator is illustrated. Thermodynamic properties are calculated for a double minimum system of optical isomers for which the forces restricting rotation must be repulsive. It is found that the entropy of such a system may be greater by nearly 0·5 unit than that of the limiting system with equal potential maxima, that is, with the symmetrical cosine potential function. A.

536.753 : 535.343.3–15 : 535.375.56 *see Abstr.* 3274

536.76 = 3 3324

New considerations on the application of the laws of thermodynamics in the wet steam range. ISSARESCU, U. *Schweiz. Arch. angew. Wiss. Tech.*, **14**, 65–70 (*March*, 1948) *In German.*—The thermodynamic scale of temperature in the wet steam range is derived using only the first law of thermodynamics and the "equation of state," $v = xv'' + (1 - x)v'$, where $xv''/(1 - x)v'$ is the ratio of the volumes of vapour and liquid, applicable to the region. Hence, the entropy and Clausius–Clapeyron equation are deduced without using the 2nd law. S. V.

ELECTRICITY 537

537.081.1 : 621.3.081.1 = 4 332

On systems of electrical units. BRYLINSKI, E. *Rev. Gén. Élect.*, **57**, 200–4 (*May*, 1948) *In French.*—The confusion which may result from the use of absolute units is discussed, e.g. the connection between B and H in vacuo, in which if one is a covariant tensor the other should be a contravariant tensor. It is suggested that separate electrostatic and electromagnetic systems be retained, with the usual conventions that permittitivity and permeability in the respective systems are both unity in vacuo. G. F.

537.081.1 : 621.3.081.1 = 3 332

Comments on the introduction of new electrical units. v. STEINWEHR, H. *Z. Phys.*, **124** (*Nos* 3–6) 315–21 (1948) *In German.*—After an historical review of the conference on International Electrical Units it is advocated that these should be replaced by Giorgi's M.K.S. system with the ohm as the 4th unit. The value of the ohm should be that of a column of Hg and should not be determined from the other three units as is the "absolute ohm." The advantages are that the value of the ohm remains unchanged, and that the values of the ampere and the volt are changed by only small amounts. The connection with the absolute system of units would be maintained by the equivalence of the electrical and mechanical units of energy—the joule. L.

537.081.1 : 621.3.081.1 = 3 332

Compensated calorimeter method for determining the values of the ampere and the volt in the Giorgi [m.k.s.] system of units. v. STEINWEHR, H. *Z. Phys.*, **124** (*Nos* 3–6) 322–5 (1948) *In German.*—If this system of units is adopted it will be necessary to measure the new values of the ampere and volt in terms of the mechanical joule and the ohm. The differential calorimeter method previously described [Abstr. 2191 (1901)] would give adequate accuracy. L.

537.122 = 3 332

The degeneracy of an electron gas by pair production. KOPPE, H. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 103–11 (1948) *In German.*—The influence of the formation of electron-positron pairs on the equation of state of an electron gas is investigated. Expressions for the thermodynamical functions are derived for suitable limiting cases. For the vacuum and $kT \gg mc^2$ the pressure becomes $\frac{1}{3}\sigma T^4$ with $\sigma = 7\pi^2k^2/60c^3\hbar^3$, which 7/4 × the pressure due to black body radiation. The 10^{-4} × smaller value given by Fowler [*Statistical Mechanics*, p. 653, Cambridge (1936)] is ascribed to an error in the numerical calculation. H.

537.13 : 539.185 *see Abstr.* 3457

537.133 : 537.591.1 *see Abstr.* 3377

537.133 : 537.591.1 = 3 *see Abstr.* 3378

537.212 = 3 332

Two-dimensional field problem of two conducting planes in any position. CAP, F. *Öst. Ingen.-Arch.*, **2** (*No.* 2) 201–11 (1948) *In German.*—By assuming the conducting planes to extend to ∞ in one direction, the field between two conducting planes is found, using the Schwarz–Christoffel transform. The field due to two planes

equal width is given by an elliptic function. The field due to unequal planes leads to complicated integrals which may be solved by integrating the equivalent series term-by-term. Diagrams of typical examples are given. V. W. R.

537.212 : 535.55 *see Abstr.* 3286

537.212 : 621.317.729 3330

An electrolytic tank for exploring potential field distributions. MAKAR, R., BOOTHROYD, A. R., AND CHERRY, E. C. Letter in *Nature, Lond.*, **161**, 845–6 (*May* 29, 1948).—[Abstr. 2474 B (1948)].

537.226 : 537.311.1 *see Abstr.* 3339

537.226 : 621.315.616 : 539.434 : 539.501 *see Abstr.* 3477

537.226 : 621.317.37 3331

Dielectric measurement of liquids at microwave frequencies. CROUCH, G. E., JR. *J. Chem. Phys.*, **16**, 364–71 (*April*, 1948).—A method of measuring the dielectric properties of medium- and high-loss liquids is described. The liquid sample is placed in an open-circuit-terminated section of wave-guide, and standing wave-ratios are measured at intervals as the length of the dielectric liquid column in the wave guide is changed. The method of measuring the wavelength of the radiation in the liquid-filled wave guide is indicated. A simple procedure for calculating the dielectric properties from these measurements is presented. Some dielectric properties of liquids measured with this method at 3 cm wavelength are given. A.

537.226.1 3332

General theory of the static dielectric constant. FRÖHLICH, H. *Trans. Faraday Soc.*, **44**, 238–43 (*April*, 1948).—A general formula is derived by an extension of the methods employed by Lorentz and by Kirkwood. This formula holds in a very general way for any substance. It contains formulae due to Onsager, Clausius–Mossotti and others, as limiting cases, subject to certain specified conditions. A.

537.226.1 : 548.0 3333

Dielectric constants of crystals. II. Gypsum. NARAYANA RAO, D. A. A. S. *Proc. Indian Acad. Sci. A*, **27**, 177–83 (*March*, 1948).—Continuation [Abstr. 3529 (1947)]. The dielectric constants of gypsum in various directions were determined by a modified liquid mixture method. The principal directions of the dielectric ellipsoid are almost coincident with the principal directions of the magnetic ellipsoid. W. R. A.

537.226.2 : 539.133 : 621.317.37 3334

Measurements of dielectric constant and dipole moment of gases by the beat-frequency method. JELATIS, J. G. *J. Appl. Phys.*, **19**, 419–25 (*April*, 1948).—Critical investigation of the beat-frequency method showed that the wide discrepancies in the data of previous observers are due, in part at least, to the neglect of certain stray components in the circuits involved. An apparatus taking these factors into consideration is described, and a method for the "absolute" standardization of the equipment is given. Results of dielectric constant and dipole moment measurements for several gases are presented and compared with previous data. A.

537.226.2 : 621.317.37 : 621.392 3335

Universal curves for dielectric-filled wave guides and microwave dielectric measurement methods for liquids. SURBER, W. H., JR. *J. Appl. Phys.*, **19**, 514–23 (*June*, 1948).—[Abstr. 2807 B (1948)].

537.226.8 3336

The variation of the complex dielectric constant with frequency. BOLTON, H. C. *J. Chem. Phys.*, **16**, 486–9 (*May*, 1948).—The locus of the complex dielectric constant for the dispersion region of a polar dielectric is found in the complex dielectric constant plane, following the equation of Onsager [Abstr. 4842 (1936)], and is compared with the approximate solution of Cole [Abstr. 3370 (1938)]. The curve is plotted for the polar liquids, H_2O, C_2H_6O, and tertiary butyl alcohol, and compared with the curve deduced from Debye's equation. Calculations are made of the values of the relaxation times. The values of the molecular volume deduced from the Debye expression for the relaxation time are compared with those deduced from the van der Waals' *b* coefficient. A.

537.226.8 : 534.321.6 : 548.0 *see Abstr.* 3515

537.228.1 : 539.31 : 512.972 *see Abstr.* 3067

537.228.5 : 535.337 = 82 *see Abstr.* 3231

ELECTRIC CURRENTS 537.3

537.311 3337

The conductivity of metals at microwave frequencies. PIPPARD, A. B., REUTER, G. E. H., AND SONDHEIMER, E. H. *Phys. Rev.*, **73**, 920–1 (*April* 15, 1948).—It is shown that the formulation given by Serin [Abstr. 968 (1948)] is not in accordance with the physical nature of the problem and leads to divergencies in the mathematical theory. For a more exact formulation see Abstr. 3542 (1947) and for full solutions see Abstr. 2123 (1948). H. L.

537.311 : 532.694 *see Abstr.* 3147

537.311 : 539.16.08 3338

Conductivity induced in diamond by alpha-particle bombardment and its variation among specimens. AHEARN, A. J. Letter in *Phys. Rev.*, **73**, 1113 (*May* 1, 1948).—The results are given of ultraviolet transmission tests, X-ray diffraction tests, and α-particle bombardment tests with a number of diamond specimens. It is concluded that conductivity pulses can be induced not only in diamonds which are transparent in the u.v. but also in those which are opaque in the same region (cf. the results of Friedman *et al* [Abstr 1505 (1948)], who worked with γ rays). There is the possibility that particular specimens may be a mixture of the two types. The 5 MeV α-particles from Po produced pulses up to 2 700 μV with an input capacity of $\sim 30\ \mu\mu$F. R. W. P.

537.311.1 : 537.226 3339

Physical interaction of electrons with dielectric media. HILL, T. L. *J. Chem. Phys.*, **16**, 394–9 (*April*, 1948).—Ogg's rough calculation [Abstr. 2602 (1946)] indicating the relative ground state energetic stability of paired electrons as compared to unpaired electrons in certain dielectric media was repeated but with the opposite result. However, an approximate consideration of the complete equilibrium constant rather than just the energy factor alone suggests that a considerable number of pairs may indeed be present. The case in which the polarization of the dielectric is able to follow in detail the motion of the charged particle or particles within a cavity is discussed. A.

537.311.3 3340

Electrical resistivity of alkali metals below 20°K. MACDONALD, D. K. C., AND MENDELSSOHN, K. Letter in *Nature, Lond.*, **161**, 972–3 (*June* 19, 1948).—Apparatus previously described [Abstr. 2938 (1938)] was modified and used to determine the resistivity for the whole alkali group. For Cs there are 2 kinks in the resistance curve near 4°K, and for K there are similar anomalies between 9°K and 14°K. These anomalies are discussed but an adequate explanation is lacking at present.

537.311.33 : 538.221 *see Abstr.* 3384

537.311.33 : 621.38 3341

Use of photo-conductive semiconductors as amplifiers. RITTNER, E. S. Letter in *Phys. Rev.*, **73**, 1212–13 (*May* 15, 1948).—Considerations indicating that a photo-conductive semiconductor should be a better current amplifier than an insulator such as diamond are put forward. Preliminary experiments have been made on a thin Se layer. Using 1 kV incident electrons and voltages of ~ 200 across the cell, an amplification of 63 was obtained. This was doubled at 2 kV incident energy.

A. H. W. B.

537.311.62 : 537.312.62.029.6 *see Abstr.* 3345

537.312.5 : 621.383.4 3342

Lead selenide photo-conductive cells. STARKIEWICZ, J. *J. Opt. Soc. Amer.*, **38**, 481 (*May*, 1948).—Lead selenide layers have been developed which have a photo-conductive peak sensitivity at a wavelength of $\sim 3{\cdot}4\,\mu$ and a cut-off at $4{\cdot}5\,\mu$. Treatment with O shifts the peak response towards the shorter wavelengths. H. K. H.

537.312.62 3343

Theory of superconductivity. BORN, M., AND CHENG, K.-C. Letter in *Nature, Lond.*, **161**, 968–9 (*June* 19, 1948).—Heisenberg's recent theory [Abstr. 3203 (1947)] is criticized, and the point of view is now adopted that superconductivity is correlated with lattice structure and is not merely a consequence of the quantum theory of interaction among electrons. An empirical rule established is that those metals are superconductive for which the Fermi surface, supposed a sphere, lies very close to one set of the corners formed by the boundary planes of a Brillouin zone. An expression giving the correct order of magnitude of the transition temperature is obtained.

537.312.62 3344

Theory of superconductivity. BORN, M., AND CHENG, K.-C. Letter in *Nature, Lond.*, **161**, 1017–18 (*June* 26, 1948).—In the previous letter [Abstr. 3343 (1948)] it was shown that in certain metals the lowest energy state corresponds to a distribution with spontaneous currents. It is now shown that these currents arrange themselves in a magnetic field in such a way that, for weak fields, London's equations between current and field hold, while for strong fields deviations are to be expected. An expression for the threshold magnetic field is obtained.

537.312.62.029.6 : 537.311.62 3345

High-frequency resistance of superconductors. PIPPARD, A. B. Letter in *Nature, Lond.*, **162**, 68–9 (*July* 10, 1948). —Earlier measurements on Sn [Abstr. 3541 (1947)] have been extended to 9 200 Mc/s. The variation of resistance with frequency does not agree with the theory [Abstr. 137 (1941)].

537.323 : 538.632 : 535.215.4 = 3 3346

On the relation between thermo-power, Hall effect and photo-electric effect in natural lead sulphide. LEGRAND, K. *Z. Phys.*, **124** (*Nos* 3–6) 219–24 (1948) *In German.*—Only some of the natural crystals have photo-electric properties and these cannot be visually distinguished from inactive crystals. The intensity of the effect varies between wide limits, even over a single surface, and its polarity is not fixed. The Hall effect and the thermo-electric properties show similar fluctuations. Contact rectification is also observed. Its direction shows no correlation with the polarity of the photo-effect and neither property with the results of spectroscopic analysis. In most cases a positive photo-effect (electron current from metal to crystal) is accompanied by a positive Hall constant and a negative thermo-power. The results are interpreted in terms of the non-stoichiometric composition of t specimens. H. K.

537.365 : 541.135.5 33

The potentials of falling drops. FRUMKIN, A., AI BAGOTSKAJA, J. *J. Phys. Coll. Chem.*, **52**, 1–11 (*Jan.*, 194 —It is shown that when Hg drops fall in a visco medium, the tangential motion of the surface displac the charges of the double layer from the lower to t upper end of the drop, giving rise to a potential differen between the two ends. For drops of radius 0·6 m viscosity of the solution 13, and electrical conductiv 4×10^{-6} the potential difference between the lower a upper ends of the drop reaches 0·4 V. Measurements the potential differences between various points of liquid column in which drops are falling bear out t correctness of the expressions for the potentials of falli drops derived by Frumkin and Levich. In accordan with the theory, the absolute value of the potential falling drops first increases with increase in the char density, reaches a maximum, and then drops off. It al follows from these measurements that the relaxati time of the electrical double layer at the Hg-soluti interface in glycerol $< 2\times10^{-3}$ sec.

ELECTRIC DISCHARGES AND RADIATIONS 537

537.52 33

Non-association of chemical change with the hi frequencies in the electrical discharge. VISVANATHA K. S. *Proc. Indian Acad. Sci. A*, **27**, 300–10 (*Apr* 1948).—NO_2 gives, throughout all stages of decomposi in an ozonizer at 5 kV irradiated with visible light, negative Joshi effect of 4 to 5% in the discharge curre and a positive effect when the gas is exposed to potentia near the threshold value. W. R.

537.52 33

Development of the spark discharge. ALLIBONE, T. Letter in *Nature, Lond.*, **161**, 970–1 (*June* 19, 1948).—T corona/leader-stroke transition was studied expe mentally and one of the photographs obtained is repr duced. It records the corona at the negative high-volta point electrode (− 500 kV) and at the grounded poi electrode. The significance of the details of the phot graph in the theory of the development of the dischar is discussed.

537.523.4 : 535.338.3 *see Abstr.* 3235

537.523.5 33

Observations on arc discharges at low pressure KOFOID, M. J. *J. Appl. Phys.*, **19**, 399–404 (*April*, 1948).— Spectrographic tests to determine the presence of electro material in the arc are described. As the gas pressure w increased, for an arc of given current and length, t amount of cathode metal in the arc, as indicated l spectral line density, suddenly increased at a critic pressure. Presumably, boiling of the cathode metal too place at this pressure, which was found to increase the arc length was reduced. In this range where melti of the cathode occurred, it was found that the molte spot was at the centre of the cathode for magnetic catho material but at the edge for nonmagnetic material.

537.523.5 = 3 33

Heating and cooling of the anode flame of the carbo arc. ROHLOFF, E. *Z. Phys.*, **124** (*Nos* 3–6) 264–77 (194 *In German.*—Photographic studies were made, with rotating mirror camera, of the anode flame observed in carbon arc after short-circuiting of the electrodes. T afterglows lasted some msec, and it was concluded th the luminosity was due to thermal causes, and that t flame lost its energy mainly by radiation. J. D.

537.523.5 : 537.534.9 3352

A low voltage discharge between very close electrodes. GERMER, L. H., AND HAWORTH, F. E. Letter in *Phys. Rev.*, **73**, 1121 (*May* 1, 1948).—The volatilization of metal from electrodes in rapid transient discharges (e.g. "switching surges") is described and a mechanism of rapid electron emission from the cathode, initiated by the presence very near it of a single positive ion, is discussed. In the case described, a capacitor charged to 15–60 V is discharged in $< 10^{-7}$ sec at an electrode separation of 500–20 000 Å. J. D. C.

537.523.5 : 537.534.9 3353

Ejection of electrons by ions at high fields. NEWTON, R. R. Letter in *Phys. Rev.*, **73**, 1122 (*May* 1, 1948).—Explains the mechanism whereby a single ion may cause the ejection from a surface (given a close distance of approach) of many electrons [Abstr. 3352 (1948)]. J. D. C.

537.523.5 : 537.582 3354

On the mechanism of electron emission at the cathode spot of an arc. ROTHSTEIN, J. Letter in *Phys. Rev.*, **73**, 1214 (*May* 15); *Errata and addendum*, **74**, 228–9 (*July* 15, 1948).—A note describing a new theory of the arc discharge for low m.p. cathodes (e.g. Cu, Ag, etc.). It is suggested that a layer $\sim 10^{-5}$ cm thick of dense metal vapour covers the cathode spot, and that this layer, fed with electrons by quasi-metallic conduction from the cathode, emits electrons thermionically into the gaseous part of the discharge. A short theoretical treatment is given. J. D. C.

537.529 : 669 : 539.27 = 82 *see Abstr.* 3471

537.531 : 535.331 3355

A further discussion of the gold *L* spectrum. WOODALL, E. A. *Phil. Mag.*, **38**, 829–42 (*Dec.*, 1947).—A continuation of an earlier paper [Abstr. 1851 (1941)]. The non-diagram lines are discussed and some further microphotometric measurements are interpreted. The origin of certain satellite lines is studied, with reference to Druyvesteyn's theory. The inaccuracies arising from the mutual effect of two close lines on each other are considered, and the shift of the max. of an X-ray spectral line due to overlapping with a neighbouring line is calculated. L. S. G.

537.531 : 535.338.1/.3 = 4 3356

New emissions in *Kβ* spectra. HULUBEI, H., CAUCHOIS, Y., AND MANESCU, I. *C.R. Acad. Sci., Paris*, **226**, 764–6 (*March* 8, 1948) *In French.*—Weak $K\beta$ lines were observed in the X-ray spectra of elements of atomic number 33–44, amongst them a group of the same type between $K\alpha_1$ and $K\beta_1$. In general, increase of excitation potential favours the appearance of satellites. There are two emissions of wavelength $< \beta_2$, given the symbols β'''_{II} and β'''. The latter is not of the same type for all atoms in this group. Other lines noted are β_0, β_6, β_7 and β_8; characteristics of these lines are discussed. A. J. M.

537.531 : 548.734 *see Abstr.* 3530

537.531 : 621.384.6 3357

X-radiation from a 20 MeV betatron. BOSLEY, W., CRAGGS, J. D., NASH, W. F., AND PAYNE, R. M. *Nature, Lond.*, **161**, 1022–3 (*June* 26, 1948).—The spectrum of the radiation was investigated by a study of (1) electron-positron pairs produced in a thin Pb sheet in a Wilson chamber, (2) protons liberated in the photodisintegration of deuterons. A curve showing the variation of the number of X-ray quanta with X-ray energy is drawn and various speculations about the shape of this curve are made. L. S. G.

537.533.7 : 778.34 3358

Electron tracks in photographic emulsions. HERZ, R. H. Letter in *Nature, Lond.*, **161**, 928–9 (*June* 12, 1948).—See Abstr. 2134 (1948). Grain-counts of tracks in *NT2a* emulsion of electrons obtained by irradiating plates with X-rays of various energies show that electron energy can only be recorded by range or number of grains in the emulsion up to ~ 80 keV. Some photographs of radioactive disintegration β-ray tracks are shown; also some showing clumping of grains at the end of tracks, attributed to the Auger effect.

537.533.73 : 539.234 = 4 *see Abstr.* 3468

537.533.73 : 548.74 = 3 3359

Observations on dynamic interference phenomena in convergent electron beams. I. ACKERMANN, I. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 19–40 (1948) *In German.*—In order to study further the interference effects given by mica when examined by a convergent electron beam, attention is paid to thin sheets (up to 1 000 A) of simpler substances with layer lattices, namely paraffin, $Mg(OH)_2$, MoS_2 and PbI. Of these only the two latter give the effects looked for, viz. interference fringes accompanying Bragg reflections, and these are observed to suffer a shift where they cross a Kikuchi band and to vary with the thickness of the sheet. Particular attention is paid to PbI, an electron probe of only 1 micron diameter being used; and it is shown that the MacGillavry modification to the dynamical theory of Bethe [Abstr. 1926 (1940)] does not wholly account for the observed effects. J. T.

537.533.73 : 548.74 = 3 3360

Observations on the dynamical interference phenomena in convergent electron beams. II. ACKERMANN, I. *Ann. Phys., Lpz.* (*Folge* 6) **2** (*Nos* 1–2) 41–54 (1948) *In German.*—A detailed examination of mica is undertaken in order to study the interference effects discussed in the previous paper, including the determination of the positions of the interference minima under accurately controlled conditions of applied voltage and specimen thickness. The observed results show a systematic divergence from those to be expected on current theory, and a refinement of this is necessary to permit the calculation of structure factors from the diffraction pattern. J. T.

537.533.8 : 621.385.1.032.216 : 537.582 *see Abstr.* 3370

537.534 : 621.384.6 3361

Compact electrostatic generator for the production of positive ions. DANFORTH, W. E., HUDSPETH, E. L., MANDEVILLE, C. E., AND SWANN, C. P. *Phys. Rev.*, **73**, 1413–18 (*June* 15, 1948).—[Abstr. 2516 B (1948)].

537.534.74 : 539.185 : 530.145 *see Abstr.* 3105–6

537.534.9 : 537.523.5 *see Abstr.* 3352–3

537.542 : 539.16.08 3362

Characteristics of the parallel plate counter. MADANSKY, L., AND PIDD, R. W. Letter in *Phys. Rev.*, **73**, 1215–16 (*May* 15, 1948).—The inherent variable time delay which is observed in the G.M. counter (with conventional cylindrical electrodes) is due to the drift time of the secondary electrons from their point of production to the small avalanche region round the central wire. However, with parallel-plate geometry the whole counter volume should be uniformly avalanche-sensitive. A counter was constructed with 3-mil Cu foil electrodes, 2 in diameter and 1 mm apart, and filled with 2 atmos. of a mixture 90% A and 10% *n*-butane. With a Neher–Pickering quenching circuit (time constant 10^{-2} sec), the counting threshold was 3 000 V with a 900 V plateau. In a 70-Ω transmission line, pulses 600 V in amplitude were obtained with a rise time of 10^{-8} sec. The efficiency for the detection of electrons was 10%. The inherent time delay as measured by using a thin-walled G.M. counter and the parallel plate counter in tandem appeared to be $<$ the

accuracy of measurement, 10^{-8} sec. It should therefore be possible to measure lifetimes of $\sim 10^{-9}$ sec. R. W. P.

537.542 : 545.828 *see Abstr.* 3514

537.542 : 621.318.5 3363

Simple quenching circuit for G.M. counters. Wesolowski, J., and Makiej, B. *Acta Phys. Polon.*, **9** (*No.* 1) 59–60 (1947) *In English.*—[Abstr. 2490 B (1948)].

537.543 3364

Rebuilding of metal Geiger counting tubes. Hagen, G. E., and Loughridge, D. H. Letter in *Phys. Rev.*, **73**, 1131 (*May* 1, 1948).—An investigation of possible techniques of reviving worn-out self-quenching G.M. counters (washing with acetone, grinding the cathode surface, etc.) shows that in the type investigated (brass cathode and 0·005 in Kovar-wire anode, filled with 9 cm A and 1 cm C_2H_6O vapour) the condition of the cathode is not critical, the important factor being the condition of the central electrode. Thus an effective process of rejuvenation is provided by refilling and the installation of a new clean anode. R. W. P.

537.56 3365

Polarization effects in the ionization loss of 1-Mev electrons in carbon. Hereford, F. L. Letter in *Phys. Rev.*, **73**, 1123–4 (*May* 1, 1948).—The prediction of Halpern and Hall [Abstr. 1870 (1948)] that the reduction of the energy loss of $\sim 8\%$ of 1 MeV electrons in C due to the polarization effects has been confirmed by comparing the stopping power of C and H_2O. In this particular case the scattering absorption can be allowed for to a large extent by choosing suitable relative absorber thicknesses. This latter point is verified experimentally. W. E. D.

537.56 : 535.35 = 82 *see Abstr.* 3253

537.561 3366

The ionisation potentials of polyatomic molecules. I. Introduction and the ionisation potentials of H_2O and H_2S. Price, W. C., and Sugden, T. M. *Trans. Faraday Soc.*, **44**, 108–16 (*March*, 1948).—Electron impact methods were used. The apparatus and technique which have been found to give the most reliable results are described. The i.p.'s of water and hydrogen sulphide are given and interpreted in the light of molecular orbital theory. A.

537.561 3367

The ionisation potentials of polyatomic molecules. II. The ionisation of simple aldehydes and ketones. Sugden, T. M., and Price, W. C. *Trans. Faraday Soc.*, **44**, 116–23 (*March*, 1948).—Three ionization potentials of formaldehyde have been found, and four each for acetaldehyde and acetone. Their probable interpretation in terms of the electronic configuration of these molecules is given. The way in which the ionization potentials are affected by alkyl substituents is brought out and is interpreted as being due to induction or charge transfer effects arising in the molecule. A.

537.561 3368

Ionization and dissociation of paraffin hydrocarbons by electron bombardment. Koffel, M. B., and Lad, R. A. *J. Chem. Phys.*, **16**, 420–2 (*April*, 1948).—Appearance potential values are reported for fragments resulting from electron bombardment of the paraffin hydrocarbons as far as the hexanes, and for *n*-heptane and 2,2,3-trimethylbutane. The values for methane, ethane, propane, and the butanes are compared with previously published values. A.

537.561 : 535.333–31 *see Abstr.* 3230

537.582 ≒ 82 3369

Energy distribution of the positive potassium ions formed in surface ionization on tungsten. Tonov, N. T. *J. Exp. Theor. Phys.*, **18**, 96–100 (*Jan.*, 1948) *In Russian.*—T energy distribution of thermo-electrons and positive io of K formed by surface ionization of K, KBr and K on W was investigated in the retarding field of a cyli drical capacitor. It is shown that the energy distributi of the positive K ions in the temperature interval 1 30 2 400°K of the filament is Maxwellian, and that t temperature of the distribution of the positive io corresponds to the temperature of the distribution of t thermo-electrons emitted by the same surface.

537.582 : 537.523.5 *see Abstr.* 3354

537.582 : 537.533.8 : 621.385.1.032.216 33

Electron emission from oxide-coated cathodes unc electron bombardment. Jones, T. J. Letter in *Natu Lond.*, **161**, 846 (*May* 29, 1948).—[Abstr. 2520 B (1948

537.583 : 535.231.4 : 621.38.032.216 33

Spectral emissivity and electron emission constants thoria cathodes. Hanley, T. E. *J. Appl. Phys.*, **19**, 583 (*June*, 1948).—A method is described for forming cathoc by means of a cataphoresis process wherein a thin lay of thoria is deposited over an underlying metal. A ter perature scale determination yields for the relati between true temperature (°K) and brightness ter perature (°C) at $\lambda = 0{\cdot}65\,\mu$: $T_t = 1{\cdot}172T_b + 177$ Electron emission studies yield for the constants of t Richardson equations: $A = 2{\cdot}63$ A/cm²/deg.²; Φ $2{\cdot}67$ V for d.c. emission; $A = 5{\cdot}62$ A; $\Phi = 2{\cdot}55$ V f pulsed emission. Information was also obtained regardi the resistivity of thoria at high temperatures.

537.585 : 621.385.032.216 33

The emission of negative ions from oxide coated cathod Sloane, R. H., and Watt, C. S. *Proc. Phys. Soc., Lon* **61**, 217–34 (*Sept.*, 1948).—The negative ions emitted fr an oxide-coated cathode and nearby electrodes have be analysed, using both a demountable metal mass spect meter and glass sealed-off tubes to which normal c tube high-vacuum technique could be applied. T mass-to-charge ratios of a large number of negative ic from the different electrodes have been determin Retarding potential measurements have enabled ener distribution curves to be plotted for the more inter ion beams, and permit of discrimination between negat ions produced thermionically and those produced bombardment. Some observations have been made the dependence of the ionic thermal emission on t cathode temperature, and the variation of this emissi with time after changes in cathode temperature, accel ating field and cathode surface conditions. The resu are discussed and compared with those of other work in this field.

COSMIC RAYS 537.591

537.591 3

Production of cosmic-ray mesons. Chew, G. F. Let in *Phys. Rev.*, **73**, 1128–9 (*May* 1, 1948).—The derivat of the observed spectrum of cosmic ray mesons on assumption that these are the decay products (10 10^{-10} sec lifetime) of π-mesons formed in nuclee nucleon collisions of range about 5 cm Hg, and w average multiplicity of the π-mesons formed about is given. It is concluded that the result is in full agr ment with existing experimental data of spectrum a altitude variation of meson intensity, for a primary pro spectrum chosen to fit the latitude effect of verti particles. J. G.

537.591 : 539.18 3

Mesotron decay. Retallack, J. G. *Phys. Rev.*, 921–2 (*April* 15, 1948).—In a cloud chamber contain

15 Pb plates each 0·27 in thick, out of 16 positive mesons which appeared to stop in a plate, 5 showed what was probably the track of a decay electron. Of 27 negative mesons, only one showed a possible decay track. The result is not compatible with a suggestion of Valley and Rossi [Abstr. 1663 (1948)] that accelerated decay rather than capture takes place for negative mesons in heavy material. J. G. W.

537.591 : 539.18 *see Abstr.* 3455

537.591 : 539.185 3375

The energy distribution of neutrons in the atmosphere. KORFF, S. A., GEORGE, M. S., AND KERR, J. W. Letter in *Phys. Rev.*, **73**, 1133 (*May* 1, 1948).—The energy distribution of neutrons produced by cosmic rays has been studied to an altitude of 66 000 ft (4 cm Hg) with a BF_3 counter shielded with boron and cadmium. The relative counting rates at maximum altitudes—unshielded: 0·7 mm Cd : 7 mm B_4C : : 3·75 : 1·69 : 1·00—are substantially the same as those recorded at lower altitudes. The absolute neutron intensity is not determined. J. G. W.

537.591.08 3376

Small cloud chamber for use with unmanned balloons. LEIGHTON, R. B. Letter in *Rev. Sci. Instrum.*, **19**, 274–6 (*April*, 1948).—Has operated successfully to an altitude of 80 000 ft. The radial expansion chamber is 4 in dia. × 2 in deep and is operated by a conventional counter control. Variations of temperature over a considerable range are compensated by a pressure regulator and by use of a condensant of suitable composition adapted to the characteristics of the regulator. Compressing gas and motive power are provided by Freon evaporating in sunlight, and illumination by a 200 μF × 300 V flash at a small angle of scattering. The apparatus is surrounded by a ½ in glass fibre blanket, but thermal distortion of tracks is still considerable. Total gross weight, 20 lb. J. G. W.

537.591.1 : 537.133 = 3 3377

Protons as cosmic ray primaries. I. HÖCKER, K.-H. *Z. Phys.*, **124** (*Nos* 3–6) 351–91 (1948) *In German.*—Assuming the cosmic ray primaries to be protons, and that protons of energy greater than 3×10^9 eV give meson formation in collision with nuclei, the cross-section of, and energy transfer at, meson-forming collisions is correlated with the observed altitude variation of the hard and soft components and with the latitude effect; the main soft component at high altitude being referred to the decay of a meson of proper life of the order 10^{-8} sec. A cross-section $2 \cdot 2 \times 10^{-26}$ cm² with about ½ of the energy passing to the meson field is estimated. The ionization maximum must be determined by the free path of the electron-producing component, leading to small showers, rather than to the shower maximum of energetic electrons measured from the top of the atmosphere. J. G. W.

537.591.1 : 537.133 = 3 3378

Protons as cosmic ray primaries. II. HÖCKER, K.-H. *Z. Phys.*, **124** (*Nos* 3–6) 392–420 (1948) *In German.*—The picture given in I [Abstr. 3377 (1948)] is modified in the light of experiments by Schein and his co-workers [Abstr. 226 (1944)]. An alternative process is considered in which protons in small energy transfers lead to neutrettos which may either decay to neutrino pairs or in a further collision process lead to mesons. A cross-section is determined from neutretto formation to accord with the observed production of penetrating secondaries in paraffin at high altitudes. The bearing of the existence of the π-meson on these conclusions is considered. J. G. W.

537.591.15 : 539.18 = 4 3379

On the explanation of a group of experimental facts by the existence of a particle of intermediate mass in large cosmic ray showers. AUGER, P., DAUDIN, J., FRÉON, A., AND MAZE, R. *C.R. Acad. Sci., Paris*, **226**, 569–72 (*Feb.* 16, 1948) *In French.*—Non-electronic particles in large showers are likely to be produced in pairs, and, since they must be lightly ionizing at low momenta and since the cross-section for pair production decreases rapidly with increasing mass, these particles are tentatively assigned a mass from 3 to 10× that of the electron. The penetrating feature of extensive showers, the large spread observed by Skobeltzyn [Abstr. 1560 (1947)] and earlier observations of the authors on transition effects of these showers are discussed. J. G. W.

537.591.15 : 539.185 3380

On the presence of neutrons in the extensive cosmic-ray showers. TONGIORGI, V. Letter in *Phys. Rev.*, **73**, 923–4 (*April* 15, 1948).—Use was made of the long mean lifetime of neutrons diffusing in paraffin (~ 200 μsec) to investigate the neutron density in extensive air showers. Coincidences were observed between neutron counters surrounded by paraffin wax and the pulse from an extensive shower array delayed several μsec. The results indicate the presence of one neutron, in the energy range for which the slowing down medium is effective, for 30 or 40 electrons. J. G. W.

539.591.5 3381

The east–west asymmetry of the hard component of the cosmic radiation. SCHEIN, M., YNGVE, V. H., AND KRAYBILL, H. L. Letter in *Phys. Rev.*, **73**, 928–9 (*April*, 1948).—The east–west asymmetry for particles which penetrate 22 cm lead was measured at altitude about 31 000 ft for a range of geomagnetic latitudes from 27° to 54°. The asymmetry is small at high latitudes, but becomes large (~ 0·4) for latitudes 27°–31° and for zenith angle 30° or 45°, but not for zenith angle 60°. These results are in general agreement with the Lemaitre–Vallarta theory, provided that all primaries leading to mesons of energy greater than about 6×10^8 eV are positively charged. J. G. W.

MAGNETISM 538

538.082.74 : 550.838 3382

Measurement of magnetic susceptibility with the Hughes induction balance. DUFFIN, R. J. *Terr. Magn. Atmos. Elect.*, **51**, 419–26 (*Sept.*, 1946).

538.114 : 538.245 *see Abstr.* 3388

538.221 3383

Metastable states of nickel characterized by a high initial permeability. SNOEK, J. L., AND FAST, J. F. Letter in *Nature, Lond.*, **161**, 887 (*June* 5, 1948).—Ni bars were found to have a higher initial permeability at all temperatures after heating to the Curie point, provided they did not undergo mechanical vibration or shocks. The higher permeability usually decreased suddenly after periods of 10 min to many hours.

538.221 : 537.311.33 3384

Microwave resonance absorption in ferromagnetic semiconductors. HEWITT, W. H., JR. Letter in *Phys. Rev.*, **73**, 1118–19 (*May* 1, 1948).—Shows graphs of real and imaginary parts of both permeability and permittivity of a ferrite, $(ZnO)(MnO) \cdot 2Fe_2O_3$ measured in a waveguide at 23 958 Mc/s with various magnetic fields up to 10 000 oersteds applied parallel to the plane of the specimen. g value is 2·12, which agrees with 2·16 from measurements on a small sphere located in a resonant

cavity. Some dielectric loss exists. [See also Abstr. 1273 (1948)]. D. H. W.

538.221.08 : 621.317.4.029.5 3385

The measurement of permeability and magnetic losses of non-conducting ferro-magnetic material at high frequencies. LINDENHOVIUS, H. J., AND VAN DER BREGGEN, J. C. *Philips Res. Rep.*, **3**, 37–45 (*Feb.*, 1948).—[Abstr. 2716 B (1948)].

538.24 : 538.652 = 82 3386

The effect of thermal magnetic treatment on magnetization and magnetostriction characteristics of Al–Si–Fe alloy. SHUR, Y. S., AND LUKSHIN, A. A. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 693–5 (1948) *In Russian.*—The investigated magnetic alloy probes (5·5% Al, 9·5% Si, the rest Fe) are heated for 2 hr at 950°C and then cooled in a strong magnetic field of 68 Oe, weak field of 1·7 Oe and in absence of a magnetic field. The resulting B and $\Delta l/l$ (magnetostriction coeff.) are plotted and show agreement with Shur's theory. A. L.

538.245 3387

On the phenomenology of ferromagnetic resonance. POLDER, D. Letter in *Phys. Rev.*, **73**, 1120–1 (*May* 1, 1948).—Resonance phenomena observed when small h.f. magnetic fields are superimposed on a saturated ferromagnetic can be described in an isotropic material by relating the periodic vectors thus: $B_{x,y} = \mu H_{x,y} \mp j\beta H_{y,x}$; $B_z = H_z$, z being the saturation axis. μ and β can be evaluated using classical electrodynamics, and experimental results on ellipsoids can be explained. The method also permits the evaluation of the refractive index for an e.m. wave in a non-conducting magnetized ferromagnetic. N. F. A.

538.245 : 538.114 = 4 3388

Magnetic properties of ferrites: ferrimagnetism and antiferromagnetism. NÉEL, L. *Ann. Phys., Paris* (*Sér.* 12) **3**, 137–98 (*March–April*, 1948) *In French.*—The magnetic properties of a substance containing carriers of magnetic moment arranged on two different lattices are discussed in terms of various parameters. In some cases (ferrimagnetism) the substance behaves at low temperature like a ferromagnetic, but the exchange integrals are negative, so that the saturation magnetization at 0°K is much less than that corresponding to complete parallelism of all the spins. If the carriers are equally distributed between the two lattices the spontaneous magnetization may be 0 at all temperatures (antiferromagnetism). In terms of this theory it is possible to explain most of the observed properties of ferrites and the parameters are calculated in a number of cases. The properties of magnetite, γ-Fe_2O_3 and Mn_2Sb can also be explained. The application of the theory to experimental results on ferrites and antiferromagnetics permits the calculation of the exchange integrals. The values obtained are not coherent but may be explained by supposing the existence of "superexchange" forces between atoms, exerted through intermediary atoms. A. E. DE B.

538.245 : 538.55 3389

Magnetization in perpendicularly superposed direct and alternating fields. BECK, F. J., AND KELLY, J. M. *J. Appl. Phys.*, **19**, 551–62 (*June*, 1948).—The magnetic properties of an Fe specimen under the influence of perpendicularly superposed d.c. and a.c. fields are investigated. For the low and intermediate values of direct longitudinal magnetic field intensity the steady component of the longitudinal intensity of magnetization first increases, goes through a maximum, and then diminishes as the transverse alternating magnetic field intensity is increased. Static hysteresis loops in the longitudinal direction show a suppression of hysteresis with increasing transver alternating magnetic field intensity. However, dynam hysteresis loops in the transverse direction indicate th this suppression is merely apparent. Curves of t dynamic longitudinal magnetic induction v. transver magnetic field intensity and transverse magnetic inductio are included.

538.249 339

Effect of lattice distortions on the mean rate of propag tion of large Barkhausen discontinuities. DIJKSTRA, L. J. AND SNOEK, J. L. Letter in *Nature, Lond.*, **161**, 8 (*June 5*, 1948).

ELECTROMAGNETISM . ELECTRODYNAMIC 538.3/.5

538.3 : 530.14 = 4 *see Abstr.* 3098–9

538.312 = 3 339

On a limit theorem of electromagnetic fields. FRANK O. *Öst. Ingen.-Arch.*, **2** (*No.* 2) 89–92 (1948) *In German.*— It is shown that the "apparent potential" between points in an electric field is a minimum when the path integration lies along a line of force. Similarly, in magnetic field the apparent potential is minimum whe calculated along the magnetic line of force. This electr magnetic limit theorem is analogous to Fermat's princip in light and Maupertuis' principle in mechanics. A example shows the theorem applied to calculate th deviation of an electric line of force at the bounda of two media of different dielectric constants ar permeabilities. V. W.

538.312 : 530.12 339

On the foundations of electrodynamics. HÖSSJER, G *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 69) 13 p (1948) *In English.*—It is shown that Maxwell's equatio can be derived as the conditions that the value of certa surface integrals in a 4-dimensional space-time shou be independent of the particular surface chosen. Th Lorentz transformation is shown to correspond to suitable rotation of the axes in this space. The pap has certain affinities with the more extensive work R. Fueter on functions of quaternions (Inter. Congre Math., Oslo, 1935), and on earlier work on the Loren transformation. V. C. A.

538.55 : 538.245 *see Abstr.* 3389

538.566.3 : 621.396.11 339

An approach to the approximate solution of the ion sphere absorption problem. HACKE, J. E., JR. *Proc. Ins Radio Engrs, N.Y.*, **36**, 724–7 (*June*, 1948).—[Abst 2839 B (1948)].

538.566.3 : 621.396.11 339

A note on the phase difference between two wav reflected from the ionosphere. KELSO, J. M. Letter *J. Appl. Phys.*, **19**, 590–1 (*June*, 1948).—[Abstr. 2838 (1948)].

538.566.3 : 621.396.11 339

Anomalous effects in ionospheric absorption. APPL TON, E. V., BEYNON, W. J. G., AND PIGGOTT, W. Letter in *Nature, Lond.*, **161**, 967–8 (*June* 19, 1948).— Experiments are described which do not support Martyn absorption equivalence theorem [Abstr. 271 (1935)] which was derived on the assumption that attenuatio was caused by electronic collisional friction. Recen experiments support the hypothesis that an addition attenuating agency is the scattering or partial reflectio of waves by sporadic E-layer ionization. L. S.

538.566.3 : 621.396.812.3 3396

Diffraction from the ionosphere and the fading of radio waves. RATCLIFFE, J. A. *Nature, Lond.*, **162**, 9–11 (*July* 3, 1948).—See Abstr. 2869 B (1948).

538.567 : 621.396.11 3397

Measurements of the interaction of radio waves in the ionosphere. HUXLEY, L. G. H., FOSTER, H. G., AND NEWTON, C. C. *Proc. Phys. Soc., Lond.*, **61**, 134–46 (*Aug.*, 1948).—[Abstr. 2840 B (1948)].

MAGNETIC EFFECTS 538.6

538.614 : 541.6 = 4 3398

Magneto-optical determination of the structure of phosphorous acid. GALLAIS, F., AND VOIGT, D. *C.R. Acad. Sci., Paris*, **226**, 577–9 (*Feb.* 16, 1948) *In French.*—Magneto-rotatory power measurements, using Hg 5 780 Å, have been made on three alkyl phosphites, two alkyl phosphonates, two alkyl alkyl-phosphonates, and pure phosphorous acid (maintained in the liquid state at 76°). Moduli for phosphorous and phosphonic acids have been derived from the values for the alkyl derivatives and are 132 and $81 \cdot 2 \times 10^{-2}$; the latter value agrees well with the value for liquid H_3PO_3 and suggests that H_3PO_3 has the phosphonate structure $O \rightarrow P(OH)(OH)(H)$. W. R. A.

538.615 : 535.338.1 *see Abstr.* 3234

538.615 : 535.338.334 : 533.7 : 535.343.4–14 *see Abstr.* 3250

538.632 : 535.215.4 : 537.323 = 3 *see Abstr.* 3346

538.652 : 538.24 = 82 *see Abstr.* 3386

ATOMIC AND MOLECULAR STRUCTURE 539

539.11 : 669 3399

The metallic state. PAULING, L. Letter in *Nature, Lond.*, **161**, 1019–20 (*June* 26, 1948).—A few remarks are made concerning the resonating-valence-bond theory of metals. Each atom in the metallic phase possesses an extra orbital, the "metallic orbital," in addition to the orbitals normally occupied by electrons. This leads to great stabilization of the metal by resonance energy and to characteristic metal properties. The case of Li is discussed; and the problem of the choice between alternative structures for a metal is briefly analysed.

539.13 3400

Structure and conductivity in the VI_b group of the periodic system. VON HIPPEL, A. *J. Chem. Phys.*, **16**, 372–80 (*April*, 1948).—The progressive change in structure and conductivity (in the sequence O, S, Se, Te, and Po) and the interrelation of the two phenomena are discussed. A.

539.13 3401

A correlation between molecular vibrations and bond-forming orbitals. LINNETT, J. W., AND WHEATLEY, P. J. Letter in *Nature, Lond.*, **161**, 971–2 (*June* 19, 1948).—The orbital valency force field [Abstr. 1609 (1948)] was tested on CH_4, but the original theory failed. A modified force-field, using 3 constants, was applied to CH_4, CH_3D, CH_2D_2, CHD_3 and CD_4. It was possible to explain the 14 stretching vibration frequencies and to account for the 15 bending vibration frequencies. The force field introduces a relation between the distortion of the bonding orbitals and the molecular vibrations.

539.13 : 541.6 3402

The dissociation of diborane by electron impact. DIBELER, V. H., AND MOHLER, F. L. *J. Amer. Chem. Soc.*, **68**, 987–9 (*March*, 1948).—The mass spectrum of diborane at ionizing voltages of 50 and 70 V resembles C_2H_4 more than C_2H_6, suggesting that BH_2 is a unit structure in diborane rather than BH_3 and that two of the H atoms are not bound directly to the B atoms. W. R. A.

539.13 : 541.63 3403

Steric effects. I. Van der Waals potential energy curves. HILL, T. L. *J. Chem. Phys.*, **16**, 399–404 (*April*, 1948).—An approximate semi-empirical method is presented for estimating van der Waals' potential energy functions based on an extrapolation from the nature of the curves that are known. A.

539.132 3404

Internal molecular motions of large amplitude illustrated by the symmetrical vibration of ammonia. NEWTON, R. R., AND THOMAS, L. H. *J. Chem. Phys.*, **16**, 310–23 (*April*, 1948).—A general method is developed for separating slow internal motions of molecules from their rapid vibrations, with the rotational motion. The zero approximation for the slow motion can be obtained by Schrödinger's rule from the classical motion in which the rapid vibrations are replaced by constraints. The theory is applied to the symmetrical double-minimum vibration of NH_3, the combined vibration-rotation energy levels being evaluated as characteristic numbers of a Sturm–Liouville equation in one variable. The microwave absorption frequencies of $N^{14}H_3$ and $N^{15}H_3$ are computed, also the pure rotation frequencies in the far infra-red. A.

539.132 3405

Structure of the hydrogen fluoride dimer. EVANS, G. E., AND GLOCKLER, G. *J. Chem. Phys.*, **16**, 324–6 (*April*, 1948).—Classical electrostatics were employed to study the configuration and potential energy of the hypothetical $(HF)_2$ molecule in the gaseous state. Of the planar models studied, a *Z*-shaped structure of C_{2h} symmetry with both F — F — H angles equal to 32·5° had a minimum potential energy. A.

539.132 3406

The calculation of perturbation energies in vibrating rotating polyatomic molecules. HERMAN, R. C., AND SHAFFER, W. H. *J. Chem. Phys.*, **16**, 453–65 (*May*, 1948).—The purely vibrational contribution to the eigenvalues of the vibration-rotation Hamiltonian of a polyatomic molecule is calculated. Special attention is given to the expansion of the quantum-mechanical Hamiltonian, and to the results of the contact transformation of the Hamiltonian which simplifies the calculation of the 2nd-order energy corrections. The results of the transformation theory are presented in tabular form. For each type of perturbation term which appears in the 1st-order Hamiltonian it is possible to obtain the 2nd-order energy corrections by inspection. This procedure eliminates the need for applying the transformation to each specific problem. The use of these results is illustrated by working out in considerable detail the case of the X_2YZ_2 tetrahedrally symmetric molecular model. A.

539.132 3407

Energy of H_3^+ and H_3 by the method of molecular orbitals. PEARSON, R. G. *J. Chem. Phys.*, **16**, 502–4 (*May*, 1948).

539.132 3408

Molecular orbital calculations of vibrational force constants. I. Ethylene. PARR, R. G., AND CRAWFORD, B. L., JR. *J. Chem. Phys.*, **16**, 526–32 (*May*, 1948).—The energy levels and twisting frequency of C_2H_4 are calculated by the method of antisymmetric molecular

orbitals, no empirical data being used other than molecular dimensions. The problem is oversimplified to a 2-electron one, but encouraging results are obtained. A.

539.132 3409

Errata: Origin of the potential barrier hindering rotation in ethane and related substances. LASSETRE, E. N., AND DEAN, L. B., JR. *J. Chem. Phys.*, **16**, 553 (*May*, 1948).—See Abstr. 1289 (1948).

539.132 = 4 3410

On the rotation constant B_J of the molecular energy levels. VALATIN, J. G. *C.R. Acad. Sci., Paris*, **226**, 789–91 (*March* 8, 1948) *In French.*—It is shown that $B_J = (E_{J+1} - E_J)/(4J + 2)$, determined from the rotational levels E_J of a diatomic molecule, gives the mean value $(\overline{1/r^2})$ of the internuclear distance r. This is exact if coupling terms between the electronic motion and the rotation are ignored. G. J. K.

539.132 : 535.33–15 *see Abstr.* 3227

539.132 : 535.343.3–15 *see Abstr.* 3247

539.132 : 536.633 *see Abstr.* 3318

539.132 : 536.75 *see Abstr.* 3323

539.133 3411

Average length and radius of normal paraffin hydrocarbon molecules. TAYLOR, W. J. *J. Chem. Phys.*, **16**, 257–67 (*April*, 1948).—Formulae previously published [Abstr. 2607 (1947)] are applied to an idealized model of the normal paraffin hydrocarbons. The potential barrier for rotation about C–C single bond was compounded of the usual threefold component plus a smaller onefold component which served to stabilize the *trans* configuration of three successive bonds. Calculations are presented for a wide range of values of the parameters, and the most probable values of the parameters applicable to the normal paraffins, as determined from the thermodynamic and spectroscopic data, are discussed. The predicted ratios of the values of the average length and radius to the values calculated for free rotation are 1·76, 1·48, 1·36, and 1·29 at 0°, 100°, 200°, and 300°C, respectively. The effect of steric hindrance is discussed, and it is pointed out that the calculated values are probably appreciably low because of the neglect of steric hindrance. A.

539.133 : 621.317.37 : 537.226.2 *see Abstr.* 3334

539.152.1 = 4 3412

On the binding energy of the He^4 and He^5 nuclei. HUMBLET, J. *Physica, 's Grav.*, **14**, 285–93 (*June*, 1948) *In French.*—In the framework of the mixed (vector and pseudoscalar) meson theory, the variational method is applied to the calculation of the binding energies of He^4 and He^5. For the first nucleus, the binding energy obtained is 23 MeV. For He^5, the result is practically equivalent to those of Tyrrell and of Way [Abstr. 3481, 4183 (1939)] who used a Gaussian potential; it is confirmed that this nucleus is unstable against the emission of a neutron. A.

539.152.1 : 535.338.332 3413

On the hyperfine structure of deuterium. BOHR, A. *Phys. Rev.*, **73**, 1109–11 (*May* 1, 1948).—The slight discrepancy between theoretical and experimental values of the ratio between the h.f.s. splitting in H and D is shown to be due to the compound structure of the deuteron. An estimate of the correction, which is in approximate agreement with the observed effect, is made assuming an infinitely small range for the nuclear forces. The influence of the finite value of this range is then considered. L. P.

539.152.1 : 539.166 3414

Note on zero-zero transitions. GOLDBERGER, M. L. Letter in *Phys. Rev.*, **73**, 1119 (*May* 1, 1948).—The resu of computations of the continuous γ-ray energy spect and lifetimes for zero-zero transitions in which 1 electr and 1 quantum are emitted [cf. Sachs, Abstr. 931 (1940 Transitions are considered which have a single int mediate state of total angular momentum one, and par either the same or different from the ground state, and which the energy of the initial state above the grou state either $\geqslant$ ($\sim 20\times$) or $\leqslant$ the energy available f the transition. Reference is made to work by Goldhab *et al.* on the 2·16 min isomeric transition in Ir^{192} [Abs 1615 (1947)]. R. W.

539.152.1 : 539.18 : 530.14 *see Abstr.* 3100

539.152.1 : 548.7 34

Nuclear resonance absorption in hydrated crysta fine structure of the proton line. PAKE, G. E. *J. Che Phys.*, **16**, 327–36 (*April*, 1948).—Fine structure w observed in the nuclear paramagnetic resonance abso tion line for protons in crystalline hydrates. Measu ments on a single crystal of $CaSO_4 . 2H_2O$ show splitting into four component lines with maximu separation varying from 0 to 22 gauss, depending up the direction of the externally applied magnetic field the crystal. The number of lines and the dependence their spacing on field direction are calculated by treati the magnetic dipole-dipole interaction as a perturbati of the proton two-spin system within the water molecu Variation of the splitting with field direction determin the orientation of the line joining protons in the wat molecule. The distance between protons in the wat molecule is measured by the splitting to be 1·58 Å f $CaSO_4 . 2H_2O$; if one assumes an H — O — H bo angle of 108°, the O — H distance is 0·98 Å. Powder hydrates show a characteristic fine structure arising fro isotropic distribution in solid angle of single crys granules. This type of fine structure determines t proton-proton distance somewhat less accurately tha does the single crystal experiment.

539.152.2 34

Magnetic moment of He^3. ANDERSON, H. L., A NOVICK, A. Letter in *Phys. Rev.*, **73**, 919 (*April* 15, 194 —Nuclear magnetic resonance observed in $He^3/$ mixture at 20 atmospheres, using improved apparat with narrow band amplifier locked to 30 c/s fie modulation. Resonance at 28·02 Mc/s and 8 640 gau leads to g value of He^3 0·763 ± 0·007 times that proton. The larger moment of He^3 is evidence for char exchange currents in nuclei. D. H.

539.152.2 34

On the nuclear moments of I^{127}, Ga^{69}, Ga^{71}, and P^3 POUND, R. V. Letter in *Phys. Rev.*, **73**, 1112–13 (*May* *Erratum*, **74**, 228 (*July* 15, 1948).—Reports ma netic moments $\mu(I^{127}) = 2{\cdot}8122 \pm 0{\cdot}0030$, (spin 5/ $\mu(Ga^{69}) = 2{\cdot}0165 \pm 0{\cdot}0035$, (spin 3/2), $\mu(Ga^{71})$ 2·5611 ± 0·0030, (spin 3/2), and $\mu(P^{31}) = \pm 1{\cdot}1314$ 0·0013, (spin 1/2) all based on $\mu(Na^{23}) = 2{\cdot}217 \pm 0{\cdot}0$ nuclear magnetons (spin 3/2) and all corrected f electronic diamagnetism. Widths of lines agree wi quadrupole moments. A resonance due to Cu in t exciting coil of the recording r.f. spectrometer was al observed. D. H.

539.152.2 = 82 34

Nuclear quadrupole moment of bromine. SCHMIDT, *J. Exp. Theor. Phys.*, **18**, 101 (*Jan.*, 1948) *In Russian.*— approx. value can be calculated from the observations Tolanski and Trivedi [Abstr. 2136 (1940)]. It $+ 0{\cdot}2\times10^{-24}$ (average value for both isotopes). [S Abstr. 2206 (1947)].

539.152.3 3419

On the magnetic moment of H^3 and He^3 in the Møller–Rosenfeld theory of nuclear forces. THELLUNG, A., AND VILLARS, F. Letter in *Phys. Rev.*, **73**, 924–5 (*April* 15, 1948).—It is shown that, in the static approximation, this model gives incorrect corrections to the magnetic moments due to exchange meson currents between the nucleons. A summary of the calculations and results is given. G. J. K.

539.153 : 535.33 *see Abstr.* 3226

539.153 : 535.338.332 *see Abstr.* 3237

539.155.2 3420

The relative abundance of the zinc and cadmium isotopes. LELAND, W. T., AND NIER, A. O. Letter in *Phys. Rev.*, **73**, 1206 (*May* 15, 1948).—Using a 60° mass spectrometer [Abstr. 2916 (1947)] Nier's original measurements [Abstr. 13 (1937)] were repeated. ZnI_2^+, ZnI^+ and Zn^+ ion beams gave no systematic differences in the abundance ratios—therefore discrimination was negligible. New abundance ratios are given: the estimated accuracy is 1% for the ratio of any pair of isotopes. Similarly CdI_2^+, CdI^+ and Cd^+ were used, giving new relative abundance figures for Cd (same accuracy). The results show that the earlier measurements were in error by $\sim 20\%$ in the ratio of the most widely separated isotopes, due to discrimination. T. G. P.

539.155.2 3421

The isotopic composition of xenon. ATEN, A. H. W., JR. Letter in *Phys. Rev.*, **73**, 1206–7 (*May* 15, 1948).—Nuclei with even atomic weight are more abundant in nature than those with odd atomic weight. The anomaly of Xe^{129} is discussed—this isotope is 4 × as frequent as the sum of its two neighbours. It is suggested that the Xe^{129} was formed by β-decay of I^{129} which has a ½-life at least 10^7 years, and which should originally have had about the same abundance as the stable isotope I^{127}, and that the Xe^{129} mixed with the remaining Xe after most of the noble gases had escaped from the earth's atmosphere. T. G. P.

539.155.2 = 3 3422

A mass spectrograph for the determination of isotope abundances. PAUL, W. *Z. Phys.*, **124** (*Nos* 3–6) 244–57 (1948) *In German.*—The following properties are important for the desired use: (*a*) Mass numbers $\leqslant 350$ can be determined with a resolving power of 500. (*b*) The whole instrument can be cleaned by baking. (*c*) A very small sample is necessary (a few mg). (*d*) The error in the relative abundance should $\simeq 1\%$. The instrument consists of a 60° magnetic sector, Heil-type ion source, and a Faraday cage. A very complete description of the apparatus and circuits are given. The instrument was tested on a number of natural and artificially enriched substances, and details are included. A. H. W. B.

539.155.2 : 539.163 *see Abstr.* 3429

539.155.2 : 539.172.4 *see Abstr.* 3450

539.155.2 : 541.123.52 : 545.827 *see Abstr.* 3511

539.157 : 535.372 = 82 *see Abstr.* 3267

RADIOACTIVITY . NUCLEAR DISINTEGRATION NUCLEAR PARTICLES 539.16/.18

539.16.08 3423

Protective facings on Eastman emulsions. MAUER, P. B., AND REYNOLDS, H. L. Letter in *Phys. Rev.*, **73**, 1131 (*May* 1, 1948).—In length measurements of particle tracks using photographic emulsions with a protective surface layer of 1 μ thickness the measured track length is appreciably shorter than the true length. This effect would be exaggerated as the initial energy or entering angle is reduced. This was verified, as stopping power determinations seemed to fall outside the limits of accuracy of measurements because of variations of the thickness of the protective layer. R. H. H.

539.16.08 3424

Inorganic crystals for the detection of high energy particles and quanta. MOON, R. J. Letter in *Phys. Rev.*, **73**, 1210 (*May* 15, 1948).—Selected photomultiplier tubes, cooled with solid CO_2, were employed for the detection of the scintillations from a variety of inorganic crystals. Voltage pulses up to 50 mV were obtained but only pulses of > 1 mV were counted, this level corresponding to the liberation of some 5 000 quanta in the crystal. Pulse durations $\simeq 1$ μsec, though this was partly accounted for by the input capacity of the amplifier. Of the many crystals tried, Ca tungstate gave the best results. An 11·3 g $CaWO_4$ crystal with a 2·16 cm² polished face was compared with a standard G.M. counter using the γ-rays from a Ra source. The crystal proved to be 125 × more sensitive. Further experiments showed a counting efficiency for this crystal of nearly 100%. Naphthalene proved to be as sensitive as the tungstate for the detection of electrons from a Ra (D + E) source. R. W. P.

539.16.08 3425

Investigation of the radioactivity of rocks by the photographic method. POOLE, J. H. J., AND BREMNER, J. W. Letter in *Nature, Lond.*, **161**, 884–5 (*June* 5, 1948).—A Nuclear Research photographic plate was placed in contact with the cut surface of the rock for 1–3 weeks. The nature and distribution of the tracks found are discussed with reference to some sample photographs.

539.16.08 : 537.311 *see Abstr.* 3338

539.16.08 : 537.542 *see Abstr.* 3362

539.16.08 : 548.0 : 539.164.92 *see Abstr.* 3437

539.16.08 : 77.023.4 3426

Processing thick emulsions for nuclear research. DILWORTH, C. C., OCCHIALINI, G. P. S., AND PAYNE, R. M. Letter in *Nature, Lond.*, **162**, 102–3 (*July* 17, 1948).—A method of processing is described which gives nearly uniform development of emulsions 300 μ thick (i.e. so that grain density of tracks of equal ionization does not vary by $> 10\%$ throughout the emulsion). The plates are first soaked in water, and then in cold developer (5°c). The temperature is then raised for a suitable development period, then further action checked by a cold stop bath. Fixing is begun in a cold solution, afterwards warmed.

539.163 3427

The identification of the surplus gamma-radiation from granite. HESS, V. F., AND ROLL, J. D. *Phys. Rev.*, **73**, 916–18 (*April* 15, 1948).—A test of the intensity of the γ-radiation from KCl and K_2SO_4 gave the result that 1 g of K is equivalent to $0{\cdot}89 \times 10^{-10}$ g of Ra. This value implies that the surplus γ-radiation previously observed from Quincy granite [Abstr. 3638 (1947)] is satisfactorily explained as coming from the K in the rocks. R. W. P.

539.163 3428

On the radioactivity of K^{40}. SUESS, H. E. Letter in *Phys. Rev.*, **73**, 1209 (*May* 15, 1948).—It is shown that geochemical evidence is in favour of $> 0{\cdot}5\%$ and $< 10\%$ of decaying K^{40} being converted to A^{40}, in opposition to the experiments of Bleuler and Gabriel [Abstr. 1606 (1947)] which lead to a value of 1·9 capture processes per β-decay of K^{40}. In fact, if all data are considered, a value of $5 \pm 2\%$ for the branching ratio seems probable,

corresponding to a total ½-life period for K^{40} of $\sim 7\times10^8$ years. R. W. P.

539.163 : 539.155.2 3429

The alpha-ray emitting isotope in samarium. DEMPSTER, A. J. Letter in *Phys. Rev.*, **73**, 1125–6 (*May* 1, 1948).—A hot anode ion source was used to provide a Sm mass spectrum which was collected on a metal plate coated with graphite. α-ray plates in contact with the deposit for 170 days showed 48 tracks of length 7 μ or less only in the region between mass 150 and mass 154, suggesting that the α-ray emitting isotope is of mass 152; certain difficulties were met due to loss of deposit by sputtering, so the results should be regarded as provisional for the present. The work of Wilkins and Dempster [*Phys. Rev.*, **54**, 315 (1938)] gave isotope 148 as the α-active one. This result is attributed to accidental contamination. R. W. P.

539.163.1 3430

Reported radioactivity of osmium. ATEN, A. H. W., JR. Letter in *Nature, Lond.*, **161**, 1019 (*June* 26, 1948).—An argument is given for doubting the reported radioactivity of Os^{187} [Abstr. 1153 (1944)] and it is shown that if *K*-electron capture does occur in Os, the ½-life must be several orders of magnitude > that reported.

539.163.1/.2 : 539.167.3 3431

The decay scheme of ^{181}Hf. HEDGRAN, A., HOLE, N., AND BENEŠ, J. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 33) 9 *pp.* (1948) *In English.*—The ½-life of Hf^{181} is given as 47 days. The β- and γ-radiations were studied by means of a magnetic lens spectrometer and the coincidence technique. The continuous β-spectrum has an upper limit of 460 keV, but it was not possible to decide whether the spectrum was simple or complex. Three internal conversion lines (59, 115 and 409 keV) appear in the β-spectrum, and four lines (41·5, 112, 254 and 384 keV) in the secondary electron spectrum obtained with a Cu–Pb radiator. It is deduced that γ-rays are present with energies 128, 342 and 472 keV. γ–γ and β–γ coincidence measurements were performed and a number of possible disintegration schemes are discussed. R. W. P.

539.163.2 3432

On the use of the Kurie plot. KURIE, F. N. D. Letter in *Phys. Rev.*, **73**, 1207 (*May* 15, 1948).—If it were established that a simple continuous β-spectrum is represented in detail by the Fermi theory, then the method of the Kurie plot would be capable of disentangling a complex spectrum; but even the most careful experimental work to date on simple allowed spectra has failed to show agreement with the linear Kurie plot at low energies (< ⅓–½ of the maximum energy). Thus it is evident that a valid disintegration scheme should be supported wherever possible by information from γ-ray energies and coincidence counting data, in addition to evidence from the Kurie plot. R. W. P.

539.163.2 : 539.164 3433

The energies of α-particles from Pu^{238} and Pu^{239}. JESSE, W. P., AND FORSTAT, H. Letter in *Phys. Rev.*, **73**, 926–7 (*April* 15, 1948).—α-particle energies of 5·140 MeV for Pu^{239} and 5·493 MeV for Pu^{238} are given with an error of $\sim 0{\cdot}1\%$, corresponding to calculated air ranges of 3·67 cm and 4·07 cm. The method employed is to relate the energies of these α-particles to those of Po^{210} (5·137 MeV) by inter-comparison of the total ionization produced by each in an ion chamber. A vibrating reed electrometer and strip chart recorder working at ~ 2 counts/min are employed. R. W. P.

539.163.2 : 539.167.3 3434

The radiations from ^{187}W. HOLE, N., BENEŠ, J., AND HEDGRAN, A. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 35) 8 *pp.* (1948) *In English.*—The β- and γ-radiations we studied by means of a magnetic lens spectrometer and t coincidence technique. The β-spectrum is complex wi upper limits 1·13 and 0·65 MeV. Two conversion lin with energies 59 and 120 keV were interpreted as the and *L* conversions of a γ-ray of energy 128 keV. Th secondary electron spectrum was studied using a coppe lead radiator and γ-ray energies of 129, 462 and 652 ke were found. γ–γ coincidences showed that the two ha γ-quanta are not emitted in cascade. β–γ coincidenc disappeared for β-ray energies above 650 keV. discussion is given of the decay schemes which a possible in view of these results. R. W.

539.163.2 : 539.172 = 3 34

The isomeric nuclei of Dy, Rh and Zr. HOLE, N *Ark. Mat. Astr. Fys.*, **36 A** (*Paper* 2) 8 *pp.* (1948) *German.*—An account of investigations carried out wi a β-ray spectrograph. It was shown that 1·2-min D produces a photoelectron line of energy 93 keV, whi was interpreted as an *L* conversion line. The metastab state of Rh^{103} was produced in (p,p) and (d,pn) reaction and proved to be the daughter product of 41-day R The β-spectrum of Ru^{103} was shown to have two com ponents with upper limits 665 and 350 keV. Two phot electron lines with energies of 217 and 290 keV we found, and with 4·5-min Zr (obtained by the irradiatio of Zr by fast neutrons) one line with energy 555 keV. R. W.

539.163.4 34

Nuclear chemistry of tellurium: chemical effects isomeric transition. WILLIAMS, R. R., JR. *J. Chem. Phys* **16**, 513–19 (*May*, 1948).—The chemical consequences isomeric transitions in the nuclei Te^{127}, Te^{129}, and Te^{1} were investigated in aqueous solutions of varying com position. The nuclear reaction gives rise to chemic reduction or oxidation, and a mechanism has bee proposed to account for the observed effects.

539.164 : 539.163.2 *see Abstr.* 3433

539.164.92 : 539.16.08 : 548.0 34

The crystal counter. VAN HEERDEN, P. J. *Utrec Diss.*, 86 *pp.* (*N.V. Noord-Hollandsche Uitgeve Maatschappij, Amsterdam*, 1945) *In English.*—Energ measurements of β- and γ-radiations by existing metho are impossible when the radiations are weak. The con dition to be satisfied is that the β-radiation (in the cas of γ-rays, the secondary β-rays) be stopped over a sho path in a solid or liquid in which the ionization is s considerable that the ionization currents of individu particles are measurable. This was shown to obtain f crystals of the AgCl type kept at liquid air temperatur whereas the same effect, though predicted for diamon and zinc blende, could not be produced in these exper mentally. Investigation of the AgCl by means of hom geneous β- and α-rays showed that the β-ionizatio effect corresponded to that calculated, thus confirmi the assumption that the ionizing energy of β-particles actually a measure of the energy of these particles, or t ionization pulse proportional to the particle energ The amount of energy necessary for the formation of conduction electron is independent of the energy of t β-rays and was found to be 7·6 eV. In the case α-ray measurements ionization pulses smaller tha normal were frequently observed, and this could be trac back to the presence of a thin irregular surface laye Similar irregularities observed with β-rays we accounted for by thicker irregular surface layers. Wh the investigation left no doubt about the suitability principle of the crystal counter for energy measuremen the attempt at calibration was not successful.

539.166 : 539.152.1 *see Abstr.* 3414

539.166.2 : 539.172.11 *see Abstr.* 3446

539.167.3 3438

Gamma-radiation from the bombardment of fluorine, boron, and beryllium by protons. JACOBS, J. A., MALMBERG, P. R., AND WAHL, J. S. Letter in *Phys. Rev.*, 73, 1130 (*May* 1, 1948).—In the reaction $F^{19}(p, \alpha)O^{16*}$ the lowest resonance is at 335 keV with an actual ½-width of 4 keV, and for $B^{11}(p, \gamma)C^{12}$ at 165 keV with a ½-width of 8 keV. The angular distribution of the γ-rays was measured for these two reactions with bombarding energies slightly above the resonance point for fluorine and boron, and between angles 45° and 135° to the forward direction of the proton beam. Measurements were also made for the reaction $Be^9(p, \gamma)B^{10}$ at 340 keV, near the resonance peak. In the three cases no significant deviation from spherical symmetry was found. R. W. P.

539.167.3 3439

A new isomer of element 43 (Tc) of very small excitation energy. HUBER, O., MARMIER, P., MEDICUS, H., PREISWERK, P., AND STEFFEN, R. Letter in *Phys. Rev.*, 73, 1208–9 (*May* 15, 1948).—An isotope of Tc produced by the reaction Mo (p, n) Tc was found with a ½-life of 53 min. It is shown, from the radiation emitted, that this is an excited state 33·4 keV above the ground state and that this transition is consistent with an angular momentum change $\Delta L = 4$. The ground state (of much shorter ½-life—to be measured later) decays by positron emission and orbital electron capture. W. E. D.

539.167.3 3440

Artificial alpha-active bismuth isotopes. TEMPLETON, D. H., AND PERLMAN, I. Letter in *Phys. Rev.*, 73, 1211 (*May* 15, 1948).—On bombarding Pb with 200 MeV deuterons, 4 weak α-emitters were detected, with apparent ½-lives of 2 min, 9 min, 27 min and 1–2 hr, the latter three being identified chemically as Bi isotopes all probably of mass < 203. The α-energies of the three longer periods were $\sim 5{\cdot}5$ MeV. This energy is low to be associated with such short ½-lives, and experiments showed that the α-decay was the rare branching product of the more frequent orbital electron capture process, the branching ratios for the two longer life activities being measured as 7×10^{-4} and 6×10^{-5} respectively, making ½-lives of the α-decay, not 27 min and 1–2 hr, but 1 month and 3 yr. These α-activities indicate the same trend with Bi α-emitters as with Po, viz. a min. ½-life for a certain mass number, rising for both heavier and lighter isotopes. W. E. D.

539.167.3 3441

Decay scheme of 62-day isotope of element 43 (Tc). HUBER, O., MEDICUS, H., PREISWERK, P., AND STEFFEN, R. Letter in *Phys. Rev.*, 73, 1211–12 (*May* 15, 1948).—As a result of measurements with a magnetic lens spectrometer, absorption measurements on electrons and γ-rays, coincidence and cloud chamber measurements, a decay scheme is proposed. W. E. D.

539.167.3 3442

Radioactive contaminants in tracers. Origin, detection, identification, and removal. COHN, W. E. *Analyt. Chem.*, 20, 498–503 (*June*, 1948).—The physical and chemical principles underlying the origin, detection, and removal of radioactive impurities in tracer materials are discussed. Specific examples, drawn from every-day experience, are given as illustrations of general causes, techniques, and procedures. (39 refs.) A.

539.167.3 = 3 3443

Energy problems with artificially radioactive As^{76}. PHILIPP, K., AND REHBEIN, F. *Z. Phys.*, 124 (*Nos* 3–6) 225–43 (1948) *In German.*—The ½-life of As^{76} is $26{\cdot}1 \pm 0{\cdot}3$ hr. A semicircular-focusing β-spectrometer and coincidence counting techniques were used to study β- and γ-radiations. The complex nature of the β^- spectrum was verified, and β–γ coincidence measurements showed the existence of three partial spectra with upper limits $1{\cdot}1 \pm 0{\cdot}1$ (30%), $2{\cdot}7 \pm 0{\cdot}2$ (30%), and $3{\cdot}15 \pm 0{\cdot}05$ (40%) MeV. Coincidence absorption measurements of Compton electrons gave a γ-ray energy of $2{\cdot}1 \pm 0{\cdot}05$ MeV, while a group of weak photoelectron lines in the β-spectrum in the region 0·3–0·7 MeV indicate further γ-rays of corresponding energies. A possible disintegration scheme is presented. Search was made for the positrons found by Harteck *et al.* [Abstr. 3194 (1938)]. If these are present they have an intensity $< 1\%$ of the β^- spectrum. R. W. P.

539.167.3 : 539.163.1/.2 *see Abstr.* 3431

539.167.3 : 539.163.2 *see Abstr.* 3434

539.167.3 : 539.172.1 3444

Neutron-deficient isotopes of tellurium and antimony. LINDNER, M., AND PERLMAN, I. Letter in *Phys. Rev.*, 73, 1124–5 (*May* 1, 1948).—Sb and Te active isotopes produced in the bombardment of Sb with 200 MeV deuterons have been assigned as follows: Sb^{119} (39 hr), Sb^{122} (2·8 day), Sb^{124} (60 day), Te^{118} (6·0 day), Te^{119} (4·5 day), Te^{121} (140 day). A 6-day activity of Sb was assumed to be an isomer of the 17-min Sb^{120}, an assignment which was strengthened by results obtained from the bombardment of pure Sb^{120} by 18 MeV deuterons. A detailed discussion of the other assignments is given, some being isobars of previously separated ones. Decay mechanisms, energies of emitted particles and γ-rays are listed. W. E. D.

539.167.3 : 539.172.1 3445

Neutron deficient isotopes of rhodium and palladium. LINDNER, M., AND PERLMAN, I. Letter in *Phys. Rev.*, 73, 1202–3 (*May* 15, 1948).—Isotopes of Rh and Pd of mass number ~ 100 (i.e. ~ 20 mass units $<$ the target nucleus), produced by bombarding Sb with 200 MeV deuterons, were examined. There were found at least 6 Pd activities with a corresponding number of daughter activities. Also 3 β^--emitters, isobaric with Ag isotopes, were identified, viz. Pd^{109} (13 hr), Pd^{111} (26 min), Pd^{112} (21 hr). Two of the neutron-deficient Pd isotopes and their products were identified as follows: Pd^{101} (9 hr) → Rh^{101} (4·3 day) → Ru^{101}; Pd^{100} (4·0 day) → Rh^{100} (19·4 hr) → Ru^{100}. Such an assignment was assisted by observing the results of bombarding Rh^{103} with 50 MeV deuterons. The mechanisms of decay, energy of emitted particles and γ-rays are given for these four Pd and Rh activities. W. E. D.

539.172 : 539.163.2 = 3 *see Abstr.* 3435

539.172.1 : 539.167.3 *see Abstr.* 3444–5

539.172.11 : 539.166.2 3446

Excitation curves for the γ-radiation from light elements bombarded with α-particles from polonium. SLÄTIS, H. *Ark. Mat. Astr. Fys.*, 35 A (*Paper* 31) 19 *pp.* (1948) *In English.* Also *Nature, Lond.*, 161, 899–900 (*June* 5, 1948).—A 40 mc Po source was used in the α-particle bombardment of samples of Li, Be, B, C, N, O, F, Na, Mg, Al, Si, P, S, Cl, K, Ca, Pb. γ-ray emission was observed in the cases of Li (2·3 MeV), Be (1·7 MeV), B (3·7 MeV), N, F (3·1 MeV), Na (4·6 MeV), Mg (3·6 MeV) and Al (4·1 MeV), and the intensity of the γ-radiation measured as a function of the energy of the α-particle for all of these light elements except N. The energies are the α-particle threshold values for γ-emission. A review is given of earlier work and the results are critically discussed. R. W. P.

539.172.4 3447

Characteristics of bismuth fission with high energy particles. GOECKERMANN, R. H., AND PERLMAN, I. Letter in *Phys. Rev.*, **73**, 1127–8 (*May* 1, 1948).—The yield curve for the fission products of this process shows a single max. at a mass number 5 or 6 below the point which would be obtained for symmetrical fission (i.e. at ~ 100). It is suggested that 10 to 12 neutrons are first boiled off and the resulting nucleus generally splits into two equal parts. This leads to the conclusion that in the cases in which unequal fission does take place, the light fragment will have a n-excess (i.e. β^--unstable) and the heavy fragment will be either stable or n-deficient. Using these assumptions, and further assuming that the n/p ratio of 1·36 is the same for the fragments as for the parent nucleus, a yield curve is drawn which is in good agreement with experiment. Further it would be expected that the yield of isotopes whose n/p ratio $\neq 1{\cdot}36$ would fall well below the curve, and this is found to be the case, e.g. the yield of Pd^{112} is found to be only $\frac{1}{20}$ of that predicted from the curve; the most abundant isobar of this mass would be the stable Cd^{112}. Measurements and assignments have been made on 25 of the radioactive fission products, of which Mo^{99} is the most abundant (5%). W. E. D.

539.172.4 3448

Some elementary observations on the mode of operation of the uranium pile. LILJEBLAD, R. *Ark. Mat. Astr. Fys.*, **36 B** (*Paper* 1) 5 *pp.* (1948) *In English.*—The object of this short discussion is to prove that if it is not possible to design a pile which will enable energy to be extracted from U^{238}, then it will be possible to obtain only a quantity of energy of the same order as that available in U^{235}. An expression is obtained for s, the number of times that the energy contained in the initial U^{235} nuclei can be extracted. R. W. P.

539.172.4 = 4 3449

Stopping power of various substances for a given fission fragment of uranium. SUZOR, F. *C.R. Acad. Sci., Paris*, **226**, 795–6 (*March* 8, 1948) *In French.*—A method already described [Abstr. 2243 (1947)] was extended to obtain the stopping powers of Cu, Ag and cellulose acetate relative to Al. A. P. F.

539.172.4 : 539.155.2 3450

Mass spectrometer analysis of mercury made by neutron attachment to gold. BRADT, P., AND MOHLER, F. L. Letter in *Phys. Rev.*, **73**, 925–6 (*April* 15, 1948).—60 mg of Hg^{198} was extracted from 40 oz. of Au after neutron bombardment ($Au^{197} + n \rightarrow Au^{198} \rightarrow Hg^{198} + \beta$). Mass-spectrometer analysis showed no ordinary Hg, but a small 199 peak (0·16 ± 0·06% 198 peak) might have been due to a secondary nuclear reaction. Spectroscopic measurement showed no isotopic fine-structure. T. G. P.

539.18 3451

Decay of negative mesons in light elements. MARCH, A. Letter in *Phys. Rev.*, **73**, 1205 (*May* 15, 1948).—The small capture probability for negative mesons in light nuclei, which is indicated by the emission of decay electrons when negative mesons are stopped in such materials, is considered in terms of a fundamental length, ~ 10^{-13} cm, determined by the shortest distance at which it is in principle possible to distinguish the position of two particles. This limitation of capture probability for pseudoscalar mesons is not expected to apply to vector mesons. J. G. W.

539.18 3452

Meson scattering with nuclear excitation. BHABHA, H. J., AND DANIEL, R. R. Letter in *Nature, Lond.*, **161**, 883–4 (*June* 5, 1948).—A track found in a photographic emulsion exposed at 8 000 ft is reproduced. It is believed to be that of a meson which at one point underwent scattering with excitation of the scattering nucleus. The possibility of decay into a different type of meson is not altogether excluded.

539.18 345

Determination of the masses of charged particles observed in the photographic plate. GOLDSCHMID CLERMONT, Y., KING, D. T., MUIRHEAD, H., AND RITSO D. M. *Proc. Phys. Soc., Lond.*, **61**, 183–94 (*Aug* 1948).—A study has been made of scattering of 40 proto and 160 mesons in photographic emulsions in order determine the mass of the individual particles. The spre in the values so obtained is large, but the evidence sugges that the majority of mesons recorded by the emulsion ca be identified both with the mesons, of mass ~ 200 m commonly observed in cloud-chamber experiments ar with counters, and with the μ-mesons observed in th photographic plates. The slow particles producin nuclear disintegrations, σ-mesons, appear to contain large proportion of particles with a mass equal to th of the π-mesons.

539.18 = 4 34

On the disintegration of the meson. MARTY, C., AN PRENTKI, J. *C.R. Acad. Sci., Paris*, **226**, 787–9 (*March* 1948) *In French.*—The decay probabilities of a π-meso into a charged and a neutral particle of spin ½ are discusse and it is suggested that these μ-mesons may be excite states of particles whose ground states are the electro and neutrino. G. J. I

539.18 : 537.591 345

On the stability of the neutral meson. HINCKS, E. P AND PONTECORVO, B. Letter in *Phys. Rev.*, **73**, 1122 (*May* 1, 1948).—The decay into two photons postulate by Greisen [Abstr. 2146, 2150 (1948)] for the neutr meson, and indicated by experiments of Anderson [Abst 418 (1948)] and Lattes *et al.* [Abstr. 2237 (1947)], ha been investigated in an apparatus primarily designed t detect electron-photon coincidences from the decay c mesons stopped in graphite. It is concluded that th lifetime of the neutral mesons decaying into 2 photon must be ⩾ than 10^{-10} sec. J. G. W

539.18 : 537.591 *see Abstr.* 3374

539.18 : 537.591.15 *see Abstr.* 3379

539.18 : 539.152.1 : 530.14 *see Abstr.* 3100

539.181 : 533.56 345

Trajectories of heavy molecules in air. JACOBS, R. B AND KAPFF, S. F. *Industr. Engng Chem.*, **40**, 842–6 (*May* 1948).—Measurements of the trajectories of several com mercial pump oils in air at about 10^{-3} mm Hg indicat that the oil molecules are only slightly deflected when the collide with air molecules. This fact is in agreement with experience in the use of oil diffusion pumps where the oi jet traverses a distance of many times the mean free path of the oil molecules without being appreciably deflected Theoretical considerations indicate that the oil molecule suffer small deflections because of their relatively large masses and because they do not act as cohesive bodies during impact. It is probable that the air molecules strik only one or two of the outermost H atoms on the oi molecule, which rebound freely on impact and late transfer this newly acquired momentum to the oil molecul as a whole. This mechanism provides the oil molecul with a certain springiness which results in a very smal transfer of momentum on collision with an air molecule. A

539.185 : 537.13 345

Angular distribution of n–p scattering with 90-Me neutrons. HADLEY, J., KELLY, E. L., LEITH, C. E., SEGRÈ

E., WIEGAND, C., AND YORK, H. F. Letter in *Phys. Rev.*, **73**, 1114–15 (*May* 1, 1948).—Scattering measurements made with a neutron beam from the 184 in cyclotron at Berkeley, produced by stripping 180 MeV deuterons on a Be target, scatterers of paraffin and polyethylene being used, show a peak of protons in the forward direction, indicating the existence of exchange forces between neutron and proton. It is also concluded that there may be comparable amounts of ordinary forces. J. T.

539.185 : 537.534.74 : 530.145 *see Abstr.* 3105–6

539.185 : 537.591 *see Abstr.* 3375

539.185 : 537.591.15 *see Abstr.* 3380

STRUCTURE OF SOLIDS 539.2

539.211 : 539.53 3458

Structure of abraded surfaces. DANCE, J. B., AND NORRIS, D. J. Letter in *Nature, Lond.*, **162**, 71–2 (*July* 10, 1948).

539.211 : 548.74 = 3 3459

The influence of hardness on the change in texture produced by working, on crystal surfaces. LEISE, K. H. *Z. Phys.*, **124** (*Nos* 3–6) 258–63 (1948) *In German.*—An investigation, by electron diffraction methods, of the effect of polishing on the texture of non-metallic single crystal surfaces is described, and the results are discussed in relation to the hardness of the polished material. The crystals of LiF, NaCl and KBr have been investigated, as well as substances harder than LiF and softer than KBr. It is found that the harder crystals still give single crystal diffraction patterns after polishing, whereas softer crystals give powder patterns which show diminishing evidence of preferred orientation the softer the material. The depth to which the structure is disturbed is greater in the case of softer materials. The author does not agree with the conclusions of Finch [*Nature*, **138**, 1010 (1936)], and states that the Beilby hypothesis of a fluid-like surface layer on insulator surfaces is not confirmed. M. R. H.

539.211 : 548.74 = 3 3460

The structure of mechanically worked surfaces and their properties. (The question of the "Beilby layer"). RAETHER, H. *Z. Phys.*, **124** (*Nos* 3–6) 286–309 (1948) *In German.*—The methods and results of the investigation of surfaces by electron diffraction and electron microscopy are discussed. Reasons are given for the author's conclusions that the cold working or finishing of a metal surface results in the formation of a finely crystalline, rather than an amorphous surface layer, and that metal layers condensing on polished metal surfaces are not dissolved. The formation of oxide films, the increase in hardness due to mechanical working, and the recrystallization of the finely crystalline layer are dealt with. The properties of worked metal surfaces and non-metallic surfaces are compared. M. R. H.

539.211 : 548.74 = 4 3461

The preparation of clean metal surfaces by mechanical abrasion in vacuo, and the study of these surfaces by electron diffraction. COURTEL, R. *C.R. Acad. Sci., Paris*, **226**, 793–5 (*March* 8, 1948) *In French.*—The results of examining a steel surface, freshly prepared by grinding inside the electron diffraction camera, are described. At first, the pattern of α-iron appears, but this gradually gives way to a pattern consisting of a large number of well-defined spots, corresponding to a strongly oriented molecular layer formed on the steel surface by oil, etc., from the rest of the apparatus. M. R. H.

539.215.4 3462

Measurement of carbon black particles by the electron microscope and low temperature nitrogen adsorption isotherms. ANDERSON, R. B., AND EMMETT, P. H. *J. Appl. Phys.*, **19**, 367–73 (*April*, 1948).—Electron micrographs and N adsorption isotherms were compared on 6 commercial C blacks as methods for obtaining particle size and surface area values of finely divided materials. Good agreement between the two procedures was obtained for 4 of the blacks. For 2 blacks known to be porous, the areas, as measured by the N isotherms, were 5–7× as large as would be calculated from the electron microscope results. A.

539.215.9 : 621.775 3463

On the rate of sintering of metal powders. SHALER, A. J., AND WULFF, J. Letter in *Phys. Rev.*, **73**, 926 (*April* 15, 1948).—Experimental confirmation of Snoek's hypothesis that solute atoms tend to migrate preferentially in metals under stress suggests an analogous behaviour for lattice vacancies, and it is indicated that observations on the rate of sintering of Cu powder can be predicted on viscous flow theory, the viscosity resulting from preferential self-diffusion of lattice vacancies. N. F. A.

539.215.9 : 621.775 3464

Mechanism of sintering. SHALER, A. J., AND WULFF, J. *Industr. Engng Chem.*, **40**, 834–42 (*May*, 1948).—To explain the phenomena of shrinkage and expansion which occur during the heat treatment (sintering) of compacts of metal powders the authors conclude that a mechanism exists whereby the metal flows viscously under the influence of surface tension and gas pressure. Using a simplified model, the rates of shrinkage of Cu compacts at 850°C are calculated and measured. The preliminary measurements confirm the nature of the mechanism but indicate a slightly higher viscosity coefficient than is predicted on the basis of the self-diffusion coefficient of Cu. A.

539.22 : 531.19 3465

On the order-disorder transition in solids. I. MUTŌ, Y. *J. Chem. Phys.*, **16**, 519–23 (*May*, 1948).—A statistical mechanical treatment. Considering a hypothetical gas in which the molecules can occupy only lattice points of a crystal, and treating the "wrong" molecules as the gas molecules and the "right" molecules as the empty points, the partition function of a binary mixture is easily computed by applying Mayer's method. It is pointed out that the ordered state is the analogue of a condensing system. A.

539.22 : 531.19 3466

On the order-disorder transition in solids. II. MUTŌ, Y. *J. Chem. Phys.*, **16**, 524–5 (*May*, 1948).—In the previous paper [Abstr. 3465 (1948)] a study was made of order-disorder transition in crystals with equivalent sublattices when there are just the same numbers of *A* and *B* molecules. Now the case with variable numbers of molecules is considered. A.

539.23 : 532.516 : 539.27 3467

A study of lubricating wax coatings by electron diffraction. BERRY, C. R. Letter in *Phys. Rev.*, **73**, 1117 (*May* 1, 1948).—Thin coatings of carnauba wax differ in their lubricating qualities, and good lubricants give electron diffraction patterns showing considerably more preferred orientation than poor lubricants. Much of the diffraction patterns can be interpreted on the basis of the results of Karle and Brockway [Abstr. 2260 (1947)] but some features are unexplained. J. I.

539.233 : 535.215.2 = 3 *see Abstr.* 3212

539.234 : 537.533.73 = 4 3468

Orientation of thin films of cuprous oxide formed on copper. FRISBY, H. *C.R. Acad. Sci., Paris*, **226**, 572–3 (*Feb.* 16, 1948) *In French.*—Examination by electron diffraction of a thin layer of Cu_2O on a suitably cut single

crystal of Cu shows that the oxide is oriented in such a way that the binary axes of the oxide and the metal are parallel. The (110) plane of Cu_2O is parallel to the free surface of the Cu even in those cases where the Cu (110) plane makes a variety of angles with that surface. J. T.

539.26 3469

Low-angle X-ray diffraction pattern of collagen. WRIGHT, B. A. Letter in *Nature, Lond.*, **162**, 23 (*July* 3, 1948).

539.26 : 539.32.08 *see Abstr.* 3473

539.262 : 541.18 3470

An apparatus for taking X-ray diffraction pictures of volatile systems at high temperatures. HOFFMAN, O. A. Letter in *Rev. Sci. Instrum.*, **19**, 277–8 (*April*, 1948).—For X-ray diffraction of colloidal systems the specimen is enclosed in a monel metal cell with thin (0·008 in) Be windows. The cell is heated by a small electric furnace and temperatures up to 105°c can be maintained to 1°c. Only small samples (0·12–0·15 ml) are required. J. I.

539.27 : 532.516 : 539.23 *see Abstr.* 3467

539.27 : 537.529 : 669 = 82 3471

Structural changes of metals due to a condensed electrical discharge. POKROVSKI, G. I., AND LIKHTMAN, V. I. *C.R. Acad. Sci. URSS*, **59** (*No.* 4) 687–9 (1948) *In Russian.*—A 6 μF capacitor at 5 kV was discharged through a spectrally pure Al plate in $\ll 1$ μsec, the discharge power being $\sim 10^6$ kW. The resulting crystal deformation is described and illustrated by 6 microphotographs taken with a 100 kV electron microscope with a magnification of 16 000. A. L.

539.27 : 541.183 *see Abstr.* 3494

ELASTICITY . STRENGTH . RHEOLOGY 539.3/.8

539.31 : 537.228.1 : 512.972 *see Abstr.* 3067

539.319 : 539.373 3472

Strain energy in greatly deformed elastic or inelastic anisotropic engineering metals. SWAINGER, K. H. *J. Franklin Inst.*, **245**, 501–16 (*June*, 1948).—The equilibrating stresses on an orthogonal element in a strained body induce normal strains defined as relative displacement per unit length of deformed body. This vector "straining"-displacement must be a point function for continuity of the solid. The work done by the forces on the faces of an orthogonal element of unit volume in the loaded body during a differential increase of deformation is found. Integration gives the total work done on the element from the initial unstrained state up to the current state of deformation. A.

539.32 : 548.7 *see Abstr.* 3522

539.32.08 : 539.26 3473

An X-ray method of measuring Poisson's ratio. HANSTOCK, R. F., AND LLOYD, E. H. *Proc. Instn Mech. Engrs, Lond.*, **157** (*War Emergency Issue No.* 26) 52–4 (1947).—The specimen, which is a small tensile test piece, is examined at various loads by a high-angle "back-reflection" X-ray technique. At any load (the value of which need not be known) X-ray patterns are obtained for various angular settings of the specimen relative to the incident X-ray beam, and, for each setting, the shift of the diffraction lines from their original position gives the strain in a direction normal to the reflecting crystallographic planes. The strains corresponding to various angular settings of the specimen, for any one load, give a linear graph when plotted against a simple function of the orientation of these crystallographic planes, and from this graph Poisson's ratio is directly obtained. For the Al alloy "Hiduminium RR.56" the ratio = 0·36. The method described has an accuracy as good as t of the ordinary mechanical method, and provides val which apply to a single set of crystallographic planes a polycrystalline metal.

539.373 : 539.319 *see Abstr.* 3472

539.374 3

The visco-elastic behavior of a highly plasticiz nitrocellulose in compression under constant load. DOY G. J., AND BADGER, R. M. *J. Appl. Phys.*, **19**, 37 (*April*, 1948).—The behaviour was investigated over wide range of load and temperature. The load dep dence appears to require the assumption of nc Newtonian viscosity. Though the observations are r quantitatively accounted for by the Tobolsky–Eyri model, the load and temperature dependence of the ra of compression appear to have some relation to predictions of these authors.

539.374 : 539.382 3

Theory of plastic flow *versus* theory of plastic deform tion. PRAGER, W. *J. Appl. Phys.*, **19**, 540–3 (*Ju* 1948).—Typical theories of plastic flow and plas deformation are discussed, and the concept of neut change of stress is introduced which can be consider as a limiting case of either loading or unloading. therefore seems reasonable to demand that the stre strain relations for both loading and unloading shou predict the same change of strain when applied to neutral change of stress. It is shown that this conditi is satisfied by the theories of plastic flow but not by t theories of plastic deformation.

539.382 : 539.374 *see Abstr.* 3475

539.42 : 532.12 *see Abstr.* 3125

539.434 3

A theory of transient creep in metals. SMITH, C. *Proc. Phys. Soc., Lond.*, **61**, 201–5 (*Sept.*, 1948).—A n approach to the theory of transient creep in metals described and the relation $\alpha = \text{const.} \times T(1 - \varepsilon^{-Ct}$ deduced, connecting the creep strain α, the absolu temperature T and the time t. C is a constant. TI relation is compared with experimentally obtain curves.

539.434 : 537.226 : 621.315.616 : 539.501 *see Abstr.* 3477

539.501 : 539.434 : 537.226 : 621.315.616 3

Rheological properties of dielectrics. LETTERSICH, *Rep. Brit. Elect. Allied Industr. Res. Ass.* (*Ref.* L/T17 11pp. (1947).—The report deals with the creep of certa commercial dielectrics in shear and compression, spectively. The major part of the strain is elastic, b creep continues for years. Results of dynamic tests polythene are given. L. G.

539.53 : 539.211 *see Abstr.* 3458

539.893 3

The compression of 39 substances to 100 000 kg/cm BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, 7 55–70 (*March*, 1948).—The apparatus and method a outlined, and the results given in tables: 22 elements, bimolecular compounds, quartz and 6 glasses we investigated.

539.893 3

Rough compression of 177 substances to 40 000 kg/cm BRIDGMAN, P. W. *Proc. Amer. Acad. Arts Sci.*, 7 71–87 (*March*, 1948).—Results for various plastic glasses and minerals, 15 elements, 8 inorganic and organic compounds with transitions, 25 miscellaneo compounds and 22 compounds with *o*-, *m*- and *p*-form are given in tables.

PHYSICAL CHEMISTRY 541

PHASE EQUILIBRIUM 541.121/.123

541.123.2 3480

Physical properties of benzene-methanol mixtures. WILLIAMS, G. C., ROSENBERG, S., AND ROTHENBERG, H. A. *Industr. Engng Chem.*, **40**, 1273–6 (*July*, 1948).—Data and curves are presented for densities, refractive indices, boiling points, specific heats, heats of mixing, and enthalpies of boiling liquid and saturated vapour for the azeotropic system, benzene-methanol. Results approximately confirm the reported position of the azeotope, but indicate that the maxima and minima for other properties are at other compositions. A.

541.123.52 : 539.155.2 : 545.827 *see Abstr.* 3511

REACTION KINETICS 541.124/.128

541.124 : 519.2 3481

On the probability formulation of chemical reaction kinetics. CHIEN, J.-Y. Letter in *J. Chem. Phys.*, **16**, 426 (*April*, 1948).

541.126 : 532.59 *see Abstr.* 3138

541.126 : 534.222.2 *see Abstr.* 3181

541.126 : 536.71 : 533.75 *see Abstr.* 3167

541.127 3482

The reaction of hydrogen atoms with the paraffin hydrocarbons. TROST, W. R., AND STEACIE, E. W. R. *J. Chem. Phys.*, **16**, 361–4 (*April*, 1948).

541.127 : 535.322 *see Abstr.* 3222

541.127.4 3483

A simplified method for computing the equilibrium composition of gaseous systems. KRIEGER, F. J., AND WHITE, W. B. *J. Chem. Phys.*, **16**, 358–60 (*April*, 1948).—The method presents a system of n equations in n unknowns in such a form that each of the major components is given as a linear expression of the minor components only, while the logarithm of each of the minor components is given as a linear expression in terms of (*a*) the free energy change for the dissociation reaction which defines the minor component and (*b*) the logarithms of the major components and the total pressure. A.

541.128 : 541.183 *see Abstr.* 3495

541.128 : 542.952 *see Abstr.* 3504

ELECTROCHEMISTRY 541.13

541.133 3484

The conductance of sodium and potassium chlorides in 50-mole percent methanol-water mixtures. SCHIFF, H. I., AND GORDON, A. R. *J. Chem. Phys.*, **16**, 336–9 (*April*, 1948).—The conductance was measured at concentrations from 0·0005 to 0·01 N. The data can be represented within experimental error by the Onsager–Shedlovsky equation, the limiting conductances being 66·62 and 75·10, respectively. The limiting conductances of chloride ion, obtained from these values, and the limiting transference numbers [Abstr. 3485 (1948)] satisfy the rule of independent ionic mobilities, but at finite concentrations the Cl ion conductance is less for the K salt than for the Na. The decrease in limiting ion conductances as compared with those in water $>$ can be accounted for by viscosity alone. The results are also in disagreement with the Bjerrum theory of ion pair formation if the mean ionic diameter, determined thermodynamically, is significant in transport processes. A.

541.133 3485

The transference numbers of sodium and potassium chlorides in 50-mole percent methanol-water mixtures. SHEMILT, L. W., DAVIES, J. A., AND GORDON, A. R. *J. Chem. Phys.*, **16**, 340–3 (*April*, 1948).—The numbers have been measured at 25°C for concentrations from 0·005 to 0·08 N, employing both autogenic cation and sheared anion boundaries. In the cation measurements, there was no progression in t_+ as the boundary moved up the tube, and t_+ was independent of current; the same was true of the anion measurements at 0·02 N over a considerable range of indicator ion concentration, and the sum $t_+ + t_-$ was unity within experimental error. At 0·05 N, however, the measured t_- varied with current and at moderate and high currents frequently showed progression with boundary movement. The Longsworth function t'°_+ is linear in concentration for the more dilute solutions, but the plot is definitely curved for the more concentrated. For both salts t°_+ is greater than in water, and the variation of t_+ with concentration is distinctly different from that obtaining for aqueous solutions. A possible explanation is given for the latter effect. A.

541.133.1 3486

A simple moving-boundary apparatus. DAVIES, R. H. Letter in *Nature, Lond.*, **161**, 1021 (*June* 26, 1948).—A short discussion of apparatus for the measurement of transport numbers [Abstr. 3889 (1934)], and its comparison with more recent apparatus [Abstr. 2227 (1948)].

541.135.5 : 537.365 *see Abstr.* 3347

PHOTOCHEMISTRY 541.14

541.143 3487

The mercury photosensitized reactions of ethane. DARWENT, B. DEB., AND STEACIE, E. W. R. *J. Chem. Phys.*, **16**, 381–6 (*April*, 1948).

COLLOIDS . DISPERSE SYSTEMS 541.18/.182

541.18 : 539.262 *see Abstr.* 3470

541.18.041 : 534.321.9 = 5 *see Abstr.* 3194

541.182 3488

The effect of size, shape, and flexibility of the solute molecules on the properties of colloidal solutions. HUGGINS, M. L. *J. Phys. Coll. Chem.*, **52**, 248–59 (*Jan.*, 1948).—Using a non-lattice treatment, equations have been deduced for the concentration-dependence of the partial molal entropy of the solvent in a dilute solution containing large solute molecules, as a function of their size and shape. Some of the shape constants, for spherical and rod-like solutes, have been evaluated. Insofar as there is overlapping, the results are in agreement with those obtained by Zimm, extending the theoretical work of McMillan and Mayer. Flexibility of the solute molecules should have little effect on the results, unless the heat of mixing is not negligible. A.

541.182.4 : 541.24 3489

Turbidimetric determination of the molecular weight of micelles of dihexyl sodium sulfosuccinate in water. STAMM, R. F., MARINER, T., AND DIXON, J. K. Letter in *J. Chem. Phys.*, **16**, 423–4 (*April*, 1948).

541.182.6 : 532.133 *see Abstr.* 3127–9

541.182.6 : 535.43 3490

Monodisperse colloids and higher-order Tyndall spectra. LA MER, V. K. *J. Phys. Coll. Chem.*, **52**, 65–75 (*Jan.*, 1948).—It is shown that the laws relating to the optical

properties of scattering and transmission and the insecticidal (deposition) properties of aerosols and hydrosols may be determined in an unambiguous fashion by employing strictly monodisperse preparations of controllable particle size. A.

ADSORPTION 541.183

541.183 3491

A dual-surface B.E.T. adsorption theory. WALKER, W. C., AND ZETTLEMOYER, A. C. *J. Phys. Coll. Chem.*, **52**, 47–58 (*Jan.*, 1948).—This theory involves the concept of an adsorbing surface made up of two portions differing in their *c*'s or heats of adsorption. Adsorption data for such a surface show the following characteristics when plotted according to the usual linear form of the B.E.T. equation: (1) Both *c*'s large: linear from 0·05 to 0·35 relative pressure with points falling below the straight line at lower pressures. (2) One *c* small: concave to the pressure axis. When the B.E.T. plot is concave to the pressure axis from 0·05 to 0·35, the v_m obtained from the best straight line in this region is too small. The value of *c* and the error in v_m are given for a wide range of *c*'s for the two portions of the surface. The dual-surface equation presents a method for measuring the extent of a portion of a solid surface by physical adsorption. Methods are presented for analysing appropriate data for the "true" total v_m and the relative amounts of the two surfaces present. A.

541.183 3492

Relation between the Brunauer–Emmett–Teller and Harkins–Jura isotherms. SMITH, T. D., AND BELL, R. Letter in *Nature, Lond.*, **162**, 109–10 (*July* 17, 1948).—Livingston's analysis [Abstr. 3712 (1947)] has been extended to include the complete form of the B.E.T. equation. The significance of the constant *n* is pointed out; its physical basis is not known, but if it depends on the size of the pores, it appears that when these $<$ a certain critical value, the H.J. equation cannot be applied to adsorption data.

541.183 : 532.613.4 = 4 3493

Influence of temperature on adsorption at interfaces. Case of paraffin oil activated by oleic acid. TRILLAT, J. J., AND BRIGONNET, J. *C.R. Acad. Sci., Paris*, **226**, 803–5 (*March* 8, 1948) *In French.*—Oleic acid (1 acid: 6 000 oil) produced a greater reduction Δ in the interfacial tension of liquid paraffin-water than does stearic acid [Abstr. 2233 (1948)]. The time required to reach equilibrium decreases linearly with rise in temperature. Δ shows an abrupt increase at 44° corresponding to a transition from a condensed state of the oleic acid film ($<$ 44°) to one less condensed ($>$ 44°). S. J. G.

541.183 : 533.5 *see Abstr.* 3161

541.183 : 539.27 3494

Electron diffraction by fatty acid layers on metal surfaces. COWLEY, J. M. *Trans. Faraday Soc.*, **44**, 60–8 (*Jan.–Feb.*, 1948).—The structure and effect of heating of layers of palmitic acid on various metals was investigated. The temperature at which the orientation of the molecules is lost, is below the bulk melting point for crystalline layers, and is 105°C for monolayers, being independent of the metal used as base. A new orientation in layers formed is described, corresponding to an orthorhombic structure and giving a characteristic pattern. Such layers are not soluble in the usual solvents, do not lose their orientation until heated to over 400°C, and remain on the surface in crystalline form to about 800°C. It is suggested that these properties arise from a change taking place under the influence of the electron beam. A.

541.183 : 541.128 34

On the structure of a catalyst surface. SIPS, *J. Chem. Phys.*, **16**, 490–5 (*May*, 1948).—A method described for calculating rigorously the distribution the adsorption energies of the sites of a catalyst surf when the adsorption isotherms are known, if the adso tion is localized and there are no interactions. T method is applied to a Freundlich isotherm, and also a new theoretical isotherm which reduces to the Freun lich type for small pressures, but exhibits saturation large pressures. It is shown that this isotherm c responds to a distribution function which differs v little from a Gaussian one. The case of atomic adsorpti of gases is also considered.

541.183.26 34

Adsorption of vapors. JOSEFOWITZ, S., AND OTHM D. F. *Industr. Engng Chem.*, **40**, 739–43 (*April*, 1948) A new apparatus, and data for the lower keton benzene, and hexane on activated carbon.

541.183.26 : 536.423.15 34

Correlating adsorption data. OTHMER, D. F., A JOSEFOWITZ, S. *Industr. Engng Chem.*, **40**, 223–5 (*Ap* 1948).—Equilibrium vapour pressures of gases vapours adsorbed on solid adsorbents are correla with adsorbate concentration, pressure, and temperatu A complete 3-dimensional evaluation of adsorption presented for vapours adsorbed on solid adsorbents o a wide range of temperatures when experimental data only one temperature are available. The method correlation is expanded into a nomograph which enab determination of adsorption isotherms when only o isotherm has been determined experimentally.

541.183.3.08 34

Some advances in techniques for the study of adsorb monolayers at the liquid-air interface. FOX, H. W., A ZISMAN, W. A. Letter in *Rev. Sci. Instrum.*, **19**, 2 (*April*, 1948).—The polymer "Teflon," which is co mercially available, is particularly suitable for making t trays, floats and barriers for studying films; it is inert cleaning agents, is stable up to 250°, is hydrophobic a oleophobic and is easily worked. Owing to the hi contact angle with many organic liquids as well as w water, trays of Teflon can be used to contain these liqui with the level of the liquid above the rim. There is suitable cement for Teflon. S. J.

541.183.56 : 536.633 *see Abstr.* 3319

ATOMIC THEORY 541.2

541.24 : 541.182.4 *see Abstr.* 3489

CHEMICAL STRUCTURE 541.4/.6

541.571.3 = 924 34

Does a semipolar double bond exist? SAMUEL, *Hebrew Tech. Coll., Haifa, Sci. Publ.*, **3**, 8–13 (1948) *Hebrew, English summary.*—This article [see also Abs 2514 (1945) and 1958 (1946)] discusses the problem as whether a second variety of covalent linkage exists besid the normal covalent band. Such an assumption w made ~ 20 years ago under the names of semipolar, co-ordinate, or dative band. Only molecules of Werne "first order" are now studied, i.e. those which are form by a central atom, and neither complex salts nor aroma substances are discussed. It is indicated that the simp dative bond of Sidgwick, Lowry and Sugden, during translation into wave mechanics, becomes, by necessi a resonance of various parent structures whose pe

centage contributions vary from molecule to molecule according to energetical conditions. It has been overlooked that in such a theory the additivity of such properties as atomic parachors, bond moments, etc., itself ceases and cannot be maintained. Since this additivity is an experimental fact, a return must be made to classical concepts, and the application of the resonance concept be reserved for aromatic and similar molecules. A thorough re-examination of the whole structure of present chemical theories is suggested. H. H. HO.

541.6 3500

Cyclic acetylenic compounds. SWORSKI, T. J. Letter in *J. Chem. Phys.*, **16**, 550 (*May*, 1948).

541.6 : 538.614 = 4 *see Abstr.* 3398

541.6 : 539.13 *see Abstr.* 3402

541.63 : 539.13 *see Abstr.* 3403

541.64 : 519.21 *see Abstr.* 3074

541.64 : 535.434 *see Abstr.* 3283

CHEMICAL PROCESSES 542.9

542.9 3501

The chemical properties of elements 94 and 93. SEABORG, G. T., AND WAHL, A. C. *J. Amer. Chem. Soc.*, **68**, 1128–34 (*March*, 1948).—The chemical properties have been investigated by the tracer technique using Pu^{238} and Np^{239}. In the reduced states, the reactions of Np and Pu resemble those of trivalent rare earths and Ac, and of tetravalent Ce, Th and U. Both resemble Ac, Th and U^{+4} in that their fluorides, iodates and hydroxides are insoluble in H_2O, their sulphides are soluble in acid, and their metals are electropositive. The fluorides have the formula NpF_3 or NpF_4 and PuF_3 or PuF_4. Both exhibit a higher oxidation state having properties similar to those of U^{+6}; oxidation-reduction potentials are given. There is practically no resemblance in the chemical properties of Np and Pu to those of Re and Os. W. R. A.

542.9 3502

Product distribution in the synthesis of hydrocarbons from carbon monoxide and hydrogen. MONTGOMERY, C. W., AND WEINBERGER, E. B. Letter in *J. Chem. Phys.*, **16**, 424–5 (*April*, 1948).

542.941 3503

The reaction of hydrogen atoms with some oxygen-containing organic compounds. TROST, W. R., DARWENT, B. DEB., AND STEACIE, E. W. R. *J. Chem. Phys.*, **16**, 353–7 (*April*, 1948).

542.952 : 541.128 3504

Catalytic isomerization of butene-1 to butene-2. TURKEVICH, J., AND SMITH, R. K. *J. Chem. Phys.*, **16**, 466–80 (*May*, 1948).

CHEMICAL ANALYSIS 543/545

545.2 3505

Photoelectric titration. RAEDER, M. G. *K. Norske Vidensk. Selsk. Skr.* (*No.* 3) 12 *pp.* (1942) *In English.*—Photoelectric indication in acidimetry with colour indicators is described and a number of titration curves is given. The possible extensions of the method to redox titrations and other analyses where colour changes occur are considered. W. R. A.

545.7 : 534.614 3506

Gas analysis apparatus employing the velocity of sound. CROUTHAMEL, C. E., AND DIEHL, H. *Analyt. Chem.*, **20**, 515–20 (*June*, 1948).—A brass tube of fixed length containing the gas has a transmitter (1–3 kc/s) at one end and a microphone at the other. Change in gas composition causes departure from resonance conditions, and change in microphone output. An amplifier feeds a meter calibrated directly in terms of the composition, and a warning can be given when one component exceeds a preset proportion.

545.8 : 621.3.042.2 : 621.317.39 3507

A direct-reading silicon meter for electrical sheet steels and a note on resistivity. ASTBURY, N. F., AND ROPER, S. P. *J. Sci. Instrum. Phys. Ind.*, **25**, 191–3 (*June*, 1948).—[Abstr. 2467 B (1948)].

545.82 3508

Qualitative organic analysis and infrared spectrometry. BARNES, R. B., GORE, R. C., STAFFORD, R. W., AND WILLIAMS, V. Z. *Analyt. Chem.*, **20**, 402–10 (*May*, 1948).—The application of infrared spectrometry to qualitative organic analysis and molecular structure determination is discussed as an approach complementary to conventional methods. A chart correlating characteristic absorption frequencies and atomic groups is presented and discussed. A.

545.82 : 535.33.03 *see Abstr.* 3228

545.824 = 82 3509

A new method of quantitative X-ray spectral analysis. BOROVSKI, I. B. *C.R. Acad. Sci. URSS*, **59** (*No.* 1) 29–32 (1948) *In Russian.*—The conventional method of analysis by X-ray emission spectra, known as the method of the internal standard, requires the introduction of a comparative quantity of a known element, or the preparation of several mixtures of the unknown and known element of varying percentage contents. The technical equipment used gives rise to a systematic error averaging 11–12%. Now it is known from optical spectral analysis that quantitative analysis is possible by measuring the width of a "standard line" on the level of the peak of a line of the element investigated. Transferring this principle to X-ray analysis, a method has been worked out that, applied to curved crystal spectrographs, works with an average error of only 2–7%, is fairly independent of the length of the exposure and insensitive to varying conditions in developing the films. Furthermore, the quantities of the element tested for and the standard element might vary from approximate equality, to differing by 1–2 orders of magnitude. A complete theory is given.

545.827 3510

The mass spectrometer in organic chemical analysis. TAYLOR, R. C., BROWN, R. A., YOUNG, W. S., AND HEADINGTON, C. E. *Analyt. Chem.*, **20**, 396–401 (*May*, 1948).—Mass spectrometer analyses of a number of mixtures such as ethylene oxide, ethylene and carbon dioxide; alkyl iodides; aliphatic chlorides, ethers and hydrocarbons; silicones; and water, ether and alcohol are presented to show the utility of the instrument when used to analyse organic substances other than the usual hydrocarbons. The analysis of gas samples as small as 10^{-4} ml and the qualitative identification of polymers and elastomers are discussed, and examples are given of organic elementary analysis for carbon, hydrogen, oxygen, sulphur and nitrogen. A.

545.827 : 541.123.52 : 539.155.2 3511

Determination of deuterium in water. FISCHER, R. B., POTTER, R. A., AND VOSKUYL, R. J. *Analyt. Chem.*, **20**, 571–2 (*June*, 1948).—Equilibrium with hydrogen gas is achieved (1 hr) by a PtO catalyst, and the gas analysed with a mass spectrometer. Formulae connecting the

isotopic composition of the gas with that of the liquid are given. A.

545.828 3512

The quantitative spectrographic analysis of the rare earth elements. I. Determination of samarium in neodymium. II. Determination of europium in samarium. FASSEL, V. A., AND WILHELM, H. A. *J. Opt. Soc. Amer.*, **38**, 518–26 (*June*, 1948).—The procedures involve the high current d.c. arc excitation of rare earth oxide-graphite mixtures. Selected lines of the major rare earth constituent are used as internal standards. The experimental error of these methods is $\sim 4\%$. Studies on the variation of the analytical intensity ratio during excitation and the effect of large changes in arc current, % graphite, and weight sample charge on the intensity ratio values are included

545.828 35

The quantitative spectrochemical determination barium, strontium, and calcium. HARTMANN, W., AI PRESCOTT, B. E. *J. Opt. Soc. Amer.*, **38**, 539–41 (*Jun* 1948).

545.828 : 537.542 35

An industrial application of Geiger–Müller counters the analysis of phosphorus in steels. BRYAN, F. R., AI NAHSTOLL, G. A. *J. Opt. Soc. Amer.*, **38**, 510–17 (*Jun* 1948).

CRYSTALLOGRAPHY 548

548.0 : 537.226.8 : 534.321.6 3515

Ultrasonic reflections by domains in rochelle-salt single crystals. PRICE, W. J. Letter in *Phys. Rev.*, **73**, 1132–3 (*May* 1, 1948).—A quartz transducer is cemented to one surface of a rochelle-salt single crystal and excited by an electric pulse of 10 Mc/s carrier frequency. An ultrasonic pulse travels through the rochelle-salt crystal and successive reflections from the opposite face are displayed on an oscillograph. Low intensity echoes from the interior of the crystal are also observed in the temperature range where the crystal is ferroelectric. A d.c. bias field progressively reduces the intensity of these domain echoes. G. F. H.

548.0 : 537.226.1 *see Abstr.* 3333

548.0 : 539.16.08 : 539.164.92 *see Abstr.* 3437

548.24 : 534.321.9 3516

Ultrasonic observations of twinning in tin. MASON, W. P., MCSKIMIN, H. J., AND SHOCKLEY, W. Letter in *Phys. Rev.*, **73**, 1213–14 (*May* 15, 1948).—A technique is described by which displacements of the order of 10^{-8} cm, occurring in times of the order of 10^{-6} sec, can be observed by amplifying the signals from a quartz crystal against which the specimen of tin is pressed. The results are interpreted as indicating twinning dislocations moving from side to side in the specimen, the magnitude of the displacement being $\sim 10\times$ what would be expected from the twinning of one pair of planes. L. G. C.

548.5 : 548.73 3517

X-ray diffraction studies in the system NiO–Cr_2O_3–ZrO_2. MILLIGAN, W. O., AND WATT, L. M. *J. Phys. Coll. Chem.*, **52**, 230–5 (*Jan.*, 1948).—The system NiO–Cr_2O_3–ZrO_2 exhibited the mutual protective action against crystallization known from some 2-component systems, and an extensive amorphous zone of composition at 500°C. In this region the protection is genuinely mutual. In samples rich in Cr_2O_3 and NiO, and not free of NH_4 nitrate, decomposition of the latter at 500°C may partially oxidize the Cr_2O_3 to form a new crystalline phase believed to be intermediate between Cr_2O_3 and CrO_3. It is detected by new diffraction lines.

548.51 = 82 3518

On the probability of the formation of crystal nuclei. GORSKI, F. K. *J. Exp. Theor. Phys.*, **18**, 45–7 (*Jan.*, 1948) *In Russian.*—In the case of piperine, betol and sulphur a satisfactory agreement of the experimental results with Frenkel's formula for the probability of the formation of crystal nuclei [Abstr. 1963 (1936)] was found. The empirical connection between the constants A and B of this formula was verified. The probability of the formation of nuclei of the same substance under different influences is the same at the temperature of vitrification, T_g. This is, in fact, the condition enabling the consta C to be normalized.

548.51 : 532.78 = 82 35

Isothermal growth of the nuclei in the decomposition a supersaturated solid solution. PINES, B. Y. *J. Ex Theor. Phys.*, **18**, 29–44 (*Jan.*, 1948) *In Russian.*—T paper deals with the question of the diffuse growth spherical nuclei either (*a*) introduced artificially as see into the super-saturated system, or (*b*) forming in t latter by fluctuations. The equation of the speed of t growth is found. An explanation of the nature of t incubation period, the protraction of which inhib crystallization, is then given. The distribution of t growing nuclei (produced by fluctuation) in the volur and its variations during the process of growing a found. The curve of crystallization against time and t final dimensions of the fully-grown nuclei are determine

548.538 : 548.74 *see Abstr.* 3535

548.7 = 3 35

On the structural changes in the surfaces of ion crystals. I. STRANSKI, I., AND MOLIÈRE, K. *Z. Phys.*, **1** (*Nos* 3–6) 421–8 (1948) *In German.*—Considers qua tatively the question of the changes in interplanar spaci arising from the polarization of the outermost layer atoms at the (001) face of NaCl, which may possibly le to the formation of molecules or groups of pairs molecules. The possibility is also put forward that the molecules can arise from the formation of surface crac of molecular dimensions. J.

548.7 = 3 35

On the structural changes in the surfaces of ion crystals. II. MOLIÈRE, K., AND STRANSKI, I. N. *Z. Phy* **124** (*Nos* 3–6) 429–40 (1948) *In German.*—Treats quan tatively the problems discussed in the previous pap [Abstr. 3520 (1948)]. J.

548.7 : 535.376 *see Abstr.* 3275

548.7 : 539.152.1 *see Abstr.* 3415

548.7 : 539.32 35

A quantum mechanical calculation of the cohesi energy, the interionic distance, and the elastic constants some ionic crystals. II. The elastic constants c_{12} and c LÖWDIN, P. O. *Ark. Mat. Astr. Fys.*, **35 A** (*Paper* 3 18 *pp.* (1948) *In English.*—The constants of face-centr cubic ionic crystals are deduced as 2nd partial d rivatives with respect to the components of the stra using the quantum-mechanical expression of the cohesi energy of an arbitrarily strained lattice. Different valu of c_{12} and c_{44} disagreeing with the Cauchy relations a obtained. This anomaly depends on a certain term in t cohesive energy expression which formally correspon

with the potential of a many-body force. The theory is applied to LiCl, NaCl, KCl, LiF, NaF and KF, and results are compared with experimental values. The sign of the difference $c_{44} - c_{12}$ is correct, but theoretical values of c_{44} are slightly too high, and those of c_{12} slightly too small. A. J. M.

548.73 3523

The crystal structures of ammonium and potassium molybdotellurates. EVANS, H. T., JR. *J. Amer. Chem. Soc.*, **68**, 1291–2 (*March*, 1948).—$(NH_4)_6TeMo_6O_{24},7H_2O$ and $K_6TeMo_6O_{24},7H_2O$ are, contrary to existing evidence, not iso-structural but possess entirely different and unrelated, although similar, symmetries. Both are orthorhombic, *m m m*; the NH_4 salt has a_0 14·62, b_0 14·91, c_0 14·26 Å, space group $Pnaa = C_{2h}^{10}$, 4 molecules per unit cell, density 2·82; whilst the K salt has a_0 14·30, b_0 14·95, c_0 14·26 Å, space group $Pbca = C_{2h}^{15}$, 4 molecules per unit cell, density 3·15. W. R. A.

548.73 3524

X-rays and the eigen-vibrations of crystal structures. RAMAN, C. V. Letter in *Nature, Lond.*, **162**, 23–4 (*July* 3, 1948).—The elastic vibrations cannot give rise to any geometric X-ray diffraction pattern related to the atomic structure of the crystal, as they are affected by various macroscopic factors. Other vibrations, specifically related to the internal structure of the crystal, and termed its eigen-vibrations, can and do exist, and the modified X-rays resulting therefrom should give rise to geometric diffraction patterns related to the internal architecture of the crystal.

548.73 3525

Oxidation of uranium dioxide (UO_2). GRØNVOLD, F., AND HARALDSEN, H. Letter in *Nature, Lond.*, **162**, 69–70 (*July* 10, 1948).—Phases with the composition $UO_{2.34}$ and $UO_{2.4}$ were detected, and lattice constants determined. The former is due to entry of O into interstitial positions of the UO_2 lattice; the latter to substitution of U with O.

548.73 3526

Crystal structure of uranium oxide (U_3O_8). GRØNVOLD, F. Letter in *Nature, Lond.*, **162**, 70 (*July* 10, 1948).—X-ray photographs gave an orthorhombic cell, $a = 6·703$, $b = 3·969$, $c = 4·136$ kx. To provide the observed density, an elementary cell with only 2 uranium atoms must be postulated (either AB_3 subtractive or AB_2 interstitial).

548.73 : 518.5 : 621.317.39 3527

Quantitative electron-density contour delineation in the electronic Fourier synthesizer for crystal structure analysis. PEPINSKY, R., AND SAYRE, D. Letter in *Nature, Lond.*, **162**, 22–3 (*July* 3, 1948).—The synthesizer [Abstr. 3725 (1947)] has been modified so that contour lines of projected electron density from one cell on any desired lattice plane can be accurately delineated. Two sample photographs of the c.r.t. presentation are given.

548.73 : 535.372 *see Abstr.* 3268

548.73 : 548.5 *see Abstr.* 3517

548.733 3528

Preferred orientation determination using a Geiger counter X-ray diffraction goniometer. DECKER, B. F., ASP, E. T., AND HARKER, D. *J. Appl. Phys.*, **19**, 388–92 (*April*, 1948).—A simple and accurate method of determining pole figures by using a special sample mount with the goniometer is described and examples are given. A correction formula is derived which takes into account absorption change and change in diffracting volume as the sample changes position with respect to the X-ray beam. A.

548.733 3529

Direct-reading contact scale for analysis of X-ray spectrometer charts. FOSTER, W. R. *Analyt. Chem.*, **20**, 489–90 (*May*, 1948).

548.734 : 537.531 3530

Achromatization of Debye-Scherrer lines. EKSTEIN, H., AND SIEGEL, S. Letter in *Phys. Rev.*, **73**, 1207–8 (*May* 15, 1948).—In order to sharpen X-ray diffraction lines so as to permit measurements of lattice parameters to be made with the ultimate limit of precision without undue loss of energy, it is proposed to "achromatize" a divergent polychromatic beam from a fine-focus X-ray tube, by reflection at a single crystal face which is so cut as to give a divergent reflected beam, each ray of which is composed of only one wavelength. This beam is reflected by a polycrystalline sample and brought to a focus. J. T.

548.735 3531

Phase determination with the aid of the implication theory. BUERGER, M. J. *Letter in Phys. Rev.*, **73**, 927–8 (*April* 15, 1948).—By a study of the relation between the implication diagram and the electron density projection on the same plane, both of which provide the locations of atoms in crystals, it is possible in many cases to determine the phase of the structure factor. J. T.

548.735.4 3532

Distribution functions and crystalline materials. BOOTH, A. D. *Trans. Faraday Soc.*, **44**, 37–40 (*Jan.–Feb.*, 1948).—The use of the distribution function for the discrete observations obtained in single crystal work is studied. The problem is approached via the Patterson series, and the classical distribution function of Warren is shown to be only one of a series of such results, applicable to observations of varying dimensions of summation. In a particular case the method is used to demonstrate the superior resolving power of the "sharpened" version of the Patterson series. A.

548.736.36 3533

The crystal structure of U_2F_9. ZACHARIASEN, W. H. Letter in *J. Chem. Phys.*, **16**, 425 (*April*, 1948).—Cubic, 4 mols in unit cell, $a = 8·4545 \pm 0·0005$ kx. Calc. density = 7·06. Each U is bonded to 9 F atoms with average U–F distance of 2·31 Å.

548.737 3534

Crystal structure of acetanilide: use of polarized infra-red radiation. BROWN, C. J., AND CORBRIDGE, D. E. C. Letter in *Nature, Lond.*, **162**, 72 (*July* 10, 1948).—The orthorhombic unit cell contains 8 molecules; $[a] = 19·50$, $[b] = 9·46$, $[c] = 7·96$ Å; space group $Pbca$–D_{2h}^{15}. The infra-red observations [Abstr. 2499 (1947)] yielded information on the directions of the C_6H_5–N, N–H, C = O, and C–CH_3 bonds, which could be used to check the projected unit-cell arrangement before "trial-and-error" calculations began.

548.74 : 537.533.73 = 3 *see Abstr.* 3359–60

548.74 : 539.211 *see Abstr.* 3459–61

548.74 : 548.538 3535

The structure and growth of PbS deposits on rocksalt substrates. ELLEMAN, A. J., AND WILMAN, H. *Proc. Phys. Soc., Lond.*, **61**, 164–73 (*Aug.*, 1948).—The structure of PbS deposits condensed from the vapour *in vacuo* on to {001}, {110}, {111} and {443} rocksalt faces has been investigated by electron diffraction. The results suggest that the deposit atoms take up positions of least potential energy relative to the substrate, as far as is permitted by the disturbing effects of collisions of incident atoms with the initial deposit crystal nuclei, and by the limited surface mobility of the deposited atoms over the substrate. This view is also supported by the nature of the changes in crystal orientation which occur when initially random deposits are heated *in vacuo*. A.

GEOPHYSICS 55

550.31 = 3 3536

Modern geophysical methods and results. PREY, A. *Experientia*, **4** (*No.* 3) 88–100 (1948) *In German, English summary.*—A review of investigations of the shape and density of the earth, its rigidity, and the propagation of seismic waves (45 refs.).

550.312 = 3 3537

The determination of the vertical gradient of gravity. KUNZ, B. F. J. *Öst. Ingen.-Arch.*, **2** (*No.* 1) 1–17 (1947) *In German.*—The "vertical gradiometer" consists of a freely suspended spring with a mass at the centre and at the free end. The instrument operates on a spring-balance principle, and enables the relative measurement of gravitation in various places and at different heights. The vertical gradient of the gravitational force can also be observed. The theory of the instrument is given, and its advantages over older methods of measurement and calculation discussed. V. W. R.

550.34.08 3538

Differential-motion seismographs. OMER, G. C., JR. *Bull. Seism. Soc. Amer.*, **37**, 197–215 (*July*, 1947).—A group of nonpendular seismographs actuated by the phase differences at two points in the earth's crust are analysed for their transient and their steady-state behaviour. The seismographs considered are the Benioff linear strain seismograph, the transversely driven rod seismograph suggested by Benioff, terminated rod seismographs of a new type, and a seismograph utilizing optical interference. A.

550.34.08 3539

An electrostatic seismometer. GANE, P. G. *Bull. Seism. Soc. Amer.*, **38**, 95–104 (*April*, 1948).—Theory and description are given of sensitive capacitor-type seismometers having small size, eddy-current damping, and an undamped period of 0·23 sec. The voltage output is taken to the grid of a cathode-follower tube within the instrument and is thereafter amplified. The suspension of the mass (by torsion wire) is of identical character in both vertical- and horizontal-component instruments. Records are given of tremors observed with a magnification of 7 000. A.

550.384 : 551.521.1 3540

Audio-frequency magnetic fluctuations. WILLIS, H. F. Letter in *Nature, Lond.*, **161**, 887–8 (*June* 5, 1948).—Magnetic fluctuations in the frequency range 5–800 c/s were detected with an amplifier-coupled induction magnetometer at an isolated site away from sources of electric disturbance. It is considered that these are of natural origin [see Abstr. 1400 (1948)]. The noise shows a rapid variation with frequency roughly as the power $-\frac{3}{2}$; beyond 1 000 c/s it was not detectable. The vertical component was often $\ll$ the horizontal.

550.384.3 3541

Induction effects in terrestrial magnetism. I. Theory. ELSASSER, W. M. *Phys. Rev.*, **69**, 106–16 (*Feb.* 1 and 15, 1946).—The paper deals with the electromagnetic effect of motions in the earth's core, considered as a fluid metallic sphere. Three independent vector solutions of the vectorial wave equation are introduced; two of these have vanishing divergence, and they are designated as toroidal and poloidal vector fields. The vector potential and electric field are toroidal, whereas the magnetic field is poloidal. The theory of the free, exponentially decaying current modes is given, leading to decay periods of the order of some tens of thousands of years. Next, the field equations in the presence of mechanical motions of the conducting fluid are set up and developed. A.

550.384.3 3

Induction effects in terrestrial magnetism. III. Elect modes. ELSASSER, W. M. *Phys. Rev.*, **72**, 821–33 (*Nov* 1947).—It can be shown that the currents in the eart core which give rise to the externally observable magne field do not form a complete set of solutions of the fi equations. There exists a second set of solutions co posed of the modes of the electric type which produc magnetic field inside the metallic sphere, but appear the outside only through an electric field too weak to measured. For reasons of symmetry the most import terms among the electric modes are the quadrupol The theory of inductive coupling by fluid motion [Abs 3246 (1946)] is here applied to the interaction of magnetic and electric modes. The system again is nc conservative, and work is done on the field by the flu or vice versa. It is shown that the interaction betwe the magnetic dipole and electric quadrupole mo constitutes a basic amplifier mechanism which amplif the quadrupole mode until the magneto-mechani forces exerted by the field upon the fluid begin to sl down the motion, thus prohibiting further increase the field. This internal quadrupole field is likely to much larger than the ordinary magnetic dipole fie Further analysis leads one to interpret the couplin between the magnetic and electric modes as a feed-ba amplifier whereby the field can be maintained through power delivered to it by the fluid motion. A survey possible sources of power for this process indicates t the power for the maintenance of the field is provid from the rotational energy lost by the earth as it is slow down through the action of the lunar tide.

550.384.4 : 551.510.535 35

Theory of geomagnetic disturbance daily variatio KALININ, J. D. *C.R. Acad. Sci. URSS*, **54** (*No.* 8) 681 (1946) *In English.*—Various deficiencies in the theory Chapman and Ferraro [Abstr. 4500 (1932), 31 (1940), 1228 (1941)] are pointed out. The assumptio now made that the daily variations depend upon tid movements of the atmosphere, produced by the passa of the earth through a neutral ionized stream of partic from the sun. An expression (empirical) is derived the current function, and its values are tabulated various latitudes and longitudes. It is concluded th the theory developed represents satisfactorily the featu of the daily variations in the ionospheric electric curre at low and middle latitudes. L. S.

550.838 : 538.082.74 *see Abstr.* 3382

550.838 : 621.317.44 35

Air-borne magnetometers for search and survey. FELC E. P., MEANS, W. J., SLONCZEWSKI, T., PARRATT, L. C RUMBAUGH, L. H., AND TICKNER, A. J. *Trans. Am Inst. Elect. Engrs*, **66**, 641–51 (1947).—See Abstr. 579 (1948).

550.93 35

Thorium-uranium ratios in the theory of genesis of le ores. SENFTLE, F. E., AND KEEVIL, N. B. *Trans. Am Geophys. Un.*, **28**, 732–8 (*Oct.*, 1947).—Thorium a uranium determinations by the thoron and radon metho have been made on 19 composite samples from 1 5 granitic and intermediate type rocks from various pa of North America. Average Th/U ratios of 3·4 and 4 were found for granitic and intermediate type roc respectively. Such ratios lend no support to Holm theory that Pb ores are derived from a source in the su stratum below the zone of ordinary magmatic activit Some regional variations in average Th/U ratios we

noted, relatively more uranium being found in the northern part of the continent. A.

ATMOSPHERE . METEOROLOGY 551.5

551.508.1 3546

The fan-type radio meteorograph of the India Meteorological Department. VENKITESHWARAN, S. P., THATTE, R. P., AND KESHAVAMURTHY, A. *Sci. Not. India Met. Dep.*, **9** (*No.* 113) 127–59 (1947).—The paper describes a simple inexpensive radiometeorograph in which the driving mechanism for making successive contacts of the pressure, dry bulb and wet bulb temperature pens is provided by a paper fan which rotates as the meteorograph is carried up by the balloon. The paper also describes the signaller, receiver and recorder and a receiving aerial with which signals can be received more satisfactorily at higher angles than with the usual vertical half-wave aerial. An inexpensive h.t. battery, that is assembled easily just before ascent, is described. The paper also gives the method of computation with the necessary tables. A.

551.508.2–31 = 3 3547

Ozone radiosonde. STRANZ, D. *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 72) 48 *pp.* (1948) *In German.*—In order to obtain daily measurements of the ozone content of the atmosphere a radio sonde was developed. Signals emitted during ascent and descent are received on the ground and provide a measure of the u.v. solar radiation received on a photoelectric cell carried by the balloon. The method for converting the radio signals to solar radiation and evaluating the ozone content are described, together with the technical difficulties and shortcomings of the method. The experiments have not been completed. R. S. R.

551.508.71 : 533.275 3548

A photoelectric hygrometer. HAMERMESH, B., REINES, F., AND KORFF, S. A. *Bull. Amer. Met. Soc.*, **28**, 330–4 (*Sept.*, 1947).—Small absolute humidity changes are measured by the photo-electric examination of the 9 440 Å water vapour bands in the absorption spectrum of 143 cm path length of air, the 8 000 Å intensity being used as a reference. Changes of $2\text{–}8\times10^{-5}$ cm of precipitable water can be measured over a small range. A.

551.510.535 3549

Eclipse-effects in *F*2-layer of the ionosphere. WELLS, H. W., AND SHAPLEY, A. H. *Terr. Magn. Atmos. Elect.*, **51**, 401–9 (*Sept.*, 1946).—Analyses of ionospheric observations of the partial eclipses of February 4–5, 1943, August 1, 1943, and January 25, 1944, show that the ionization of the F_2-layer was subnormal before the beginning of the eclipse in each case, and remained low longer than expected after the eclipse. Examination of this effect with relation to concurrent activity on the sun, especially bright regions of the corona, indicates that radiation from beyond the limb of the sun may contribute to the ionization of the region. Values of the recombination-coefficient for the F_2-layer estimated from these eclipse observations lie between 10^{-9} and 2×10^{-10}. The larger values obtained when the apparent heights, as well as the ion-densities, were lower. At Huancayo, during the January 25, 1944, eclipse, the F_2-layer rose bodily to great heights with a velocity of the order of 200 km/hr, and a new *F*-region stratification developed at normal height. A.

551.510.535 3550

On diffusion in the ionosphere. FERRARO, V. C. A. *Terr. Magn. Atmos. Elect.*, **51**, 427–31 (*Sept.*, 1946).—It is shown that Jaeger's discussion of diffusion in the ionosphere [Abstr. 910 (1946)] is applicable only to regions of the F_2-layer 100 km or more above the level of maximum ion-production. Further reasons are given for the conclusion reached in an earlier paper that, though diffusion in the F_2-layer may not be negligible (as in the case of the *E*- and F_1-regions), its effect is likely to be small. The air-density in the F_2-layer at the level of maximum electron-density is then unlikely to be much less than 10^{10} mol/cm^3. A.

551.510.535 : 550.384.4 *see Abstr.* 3543

551.510.535 : 621.396.9 : 523.53 3551

A study of transient radar echoes from the ionosphere. EASTWOOD, E., AND MERCER, K. A. *Proc. Phys. Soc., Lond.*, **61**, 122–34 (*Aug.*, 1948).—The rate of occurrence of transient bursts of ionization within the lower *E* region of the ionosphere has been systematically measured during the period January 1945 to July 1946. The activity varies both diurnally and seasonally and in such a manner as to lend support to the meteor theory of burst formation. Some measure of solar control of the rate of burst occurrence has also been detected; this effect may be explained in terms of the normal diurnal *E* region changes in density of ionization. From experiments performed during the solar eclipse of July 1945, it is concluded that the sun does not emit a burst-producing radiation. Analysis of the observations suggests that the greater proportion of the bursts are created within a thin layer located at a height of 86 km; the distribution of the bursts within this layer has proved to be uniform over wide areas and no latitude effect has been detected. It is established that the rate of incidence of bursts which present echoing areas between A and $A+\delta A$ m^2 to a radio wave of frequency ν may be expressed in the form $C\delta A/\nu^3A^{3/2}$, with C constant. A.

551.521.1 : 550.384 *see Abstr.* 3540

551.521.3 : 535.343.4–15 *see Abstr.* 3251

551.521.64 : 523.72 *see Abstr.* 3084

551.574.7 : 536.421.4 *see Abstr.* 3303

551.576.33 3552

A study of impressive wave formation in the atmosphere. STRANZ, D. *Trans. Chalmers Univ. Tech. Gothenburg* (*No.* 71) 7 *pp.* (1948) *In English.*—A photograph is given of a cloud with wave formation seen near Leipzig (Jan. 31, 1943). From upper-air observations at Erfurt and Berlin it is deduced that air ascended from ground level due to industrial heat. Its motion was checked by an inversion lying at 2 500 to 3 000 m but an oscillation resulted at this level and cloud formed. Details of the upper-air temperature and humidity and wind discontinuity are given, together with the wavelength and amplitude of the cloud waves. R. S. R.

551.593.11 3553

Meteorological conditions accompanying mirages in the Salt Lake Desert. IVES, R. L. *J. Franklin Inst.*, **245**, 457–73 (*June*, 1948).—Conditions commonly or invariably accompanying mirages in the Salt Lake Desert are here described, and the descriptions illustrated with photographs and instrumental records, where such are available and pertinent. Extended observation indicates that mirages are a standard and predictable phenomenon in the Salt Lake Desert. Less extended field studies show that similar meteorological conditions accompany mirages in all other American deserts. A.

551.594.221 : 621.316.933 3554

Lightning arrester discharge currents. CUFFE, R. C. Letter in *Nature, Lond.*, **161**, 885–6 (*June* 5, 1948).—Investigation of discharge currents of a number of

38 kV lightning arresters showed that in two cases the current discharge was not unidirectional. Four possible explanations are offered.

551.594.6 : 523.5 : 621.396.812.3 3555

Observations of scatter clouds. ECKERSLEY, T. L. Letter in *Nature, Lond.*, **162**, 24–5 (*July* 3, 1948).—See Abstr. 1396 (1948). All scatter clouds are not correl with meteors, and there is some correlation Dellinger fades, except at high frequencies. An expl tion of the origin of scatter clouds by photo-ionizatio dust particles by solar radiation is indicated. [See Abstr. 1450 B (1940); 2379 (1947)].

BIOLOGY 57/59

591.185.63 : 525.37 : 531.114 3556

Orientation of birds on migratory and homing flights. *Nature, Lond.*, **161**, 996–8 (*June* 26, 1948).—Report of a discussion. Recent work [Abstr. 1132 (1948)] is criticized, and theories of bird orientation which invoke the use of Coriolis forces for determining latitude, and the vertical component of the earth's magnetic field for supplying the second co-ordinate, are discussed.

MEDICAL SCIENCE . HUMAN PHYSIOLOGY

612.84

An illuminant-stable color vision test. I. FREEMAN *J. Opt. Soc. Amer.*, **38**, 532–8 (*June*, 1948).

612.845.522

A case of unilateral deuteranopia. SLOAN, L. L., WOLLACH, L. *J. Opt. Soc. Amer.*, **38**, 502–9 (*J* 1948).

612.85 : 534.792 : 534.75 *see Abstr.* 3200

GLASS . CERAMICS 666

666.24 : 535.661.3 *see Abstr.* 3288

METALLURGY 669

669 : 537.529 : 539.27 = 82 *see Abstr.* 3471

669 : 539.11 *see Abstr.* 3399

PHOTOGRAPHY 77

77.023.4 : 539.16.08 *see Abstr.* 3426

778.3 : 535.33.08 3559

A simple way of photographing spectra. HOUSTON, R. A. Letter in *Nature, Lond.*, **161**, 973–4 (*June* 19, 1948).—Practical details are given for the photography of prism-spectrometer spectra through a wide angle eye-piece and an ordinary camera.

778.34 : 537.533.7 *see Abstr.* 3358

778.35 3560

Choosing an emulsion and processing technique for daylight aerial photography. HOWLETT, L. E. *Canad. J. Res. A*, **26**, 60–4 (*March*, 1948).—Experiments are reported that show the relations existing between γ, useful exposure range for aerial photography, maximum resolving power, and emulsion speed as determined by the resolving power criterion. The results are used to deduce the proper choice of emulsion and processing technique for ordinary daylight aerial photography where the main requirement is the acquisition of information.

A.

778.55 : 535.735 : 535.88 = 3 3561

The physiological-optical limit of film movement and the illuminating efficiency factor of cinema projectors. NAGEL, M. *Optik*, **2**, 415–22 (*Oct.–Nov.*, 1947) *In German.*

778.643 : 535.62 3562

Color correction in color printing. HARDY, A. C., AND WURZBURG, F. L., JR. *J. Opt. Soc. Amer.*, **38**, 300–7 (*April*, 1948).—In a 3-colour print, the colour of any area that is large in comparison with the size of the dots of the structured image can be regarded as an additive mix of 8 colours: the unprinted paper stock; the c magenta, and yellow of the individual ink dots; the green, and blue that result when ink dots overla pairs; and the black that results when all three ink overlap. Since the extent of overlapping is determ by the sizes of the dots, the colour of the additive mix can be expressed by 3 equations. A simple electr network has been constructed which solves these e tions with ample precision in 0·001 sec. By using network in connection with a scanning machine [A 3563 (1948)], full colour correction is achieved.

778.643 : 621.383

A photoelectric method for preparing printing pla HARDY, A. C., AND WURZBURG, F. L., JR. *J. Opt. Amer.*, **38**, 295–300 (*April*, 1948).—Whenever the sub being reproduced has a regular pattern, the conventi type of half-tone screen, because of its regular struct may produce an objectionable beat pattern, ca moiré. In multicolour printing, the regular pattern the several structured images produce complex patterns whose effects are minimized, but not elimina through proper choice of screen angles. A procedu described in which a continuous-tone image is scan and the resulting photo-tube signal is used to actua light valve in such a manner as to produce a struct image containing dots that are, in effect, distribute random. This procedure avoids both the distortion tone reproduction and the moiré patterns associated the conventional use of half-tone screens.